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"It will flourish, if naturalists, chemists, antiquaries, philologists, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease." SIR WM. JONES.

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JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.



Vol. LXIII. Part II.—NATURAL SCIENCE.

No. IV.—1894.

Natural History Notes from H. M. Indian Marine Survey Steamer 'Investigator,' Commander C. F. Oldham, R. N., commanding. Series II., No. 17. List of the Shore and Shallow-water Brachyura collected during the Season 1893-1894.—By A. ALCOCK, M.B., C.M.Z.S., Superintendent of the Indian Museum, and A. R. ANDERSON, B.A., M.B., Surgeon-Naturalist to the Survey.

[Received 1st October—Read 7th November.]

1. INTRODUCTION.

Some explanation is due from us for having undertaken, amid much other work, to name the large collection of shore and shallow-water crabs recently made on board the 'Investigator.'

In the first place the collection, though large, is but a small part of the entire collection of *Brachyura* made during many surveying seasons; and it may, therefore, be thought that we should have waited until the whole collection could be taken in hand.

In the second place, it might be doubted whether our opportunities of actually comparing our specimens with types, or with authentically determined specimens of type value, have been sufficient.

To the first objection, we can only reply that our time for joint work is too limited, and too liable to indefinite interruption, to permit a larger undertaking.

The second objection is a serious one; for everyone knows how, even with the most complete literature and illustrations at hand, the most remarkable errors in identification are possible.

Although, thanks to the late Professor Wood-Mason, who for many years aimed at perfecting it, the literature at our call has been as complete as could be desired, yet we have been by no means entirely dependent upon figures and print.

We have had for comparison, in the first place, Dr. J. Anderson's Mergui collection, named by Dr. deMan; in the second place, a considerable number of authentically named specimens acquired by Professor Wood-Mason from European collections, by exchange; and, thirdly, the specimens named by Professor Wood-Mason himself, which specimens may have been—though we can speak with no certainty on this point—compared by him when in Europe.

Of a total number of 119 species collected, only 6 are described with some confidence as new to science, namely:—

1. *Achæus hyalinus*.
2. *Inachoides dolichorhynchus*.
3. *Arcania quinquespinosa*.
4. *Leucosilia granulosa*.
5. *Dorrippe polita*.
6. *Cymopolia serripes*.

Of the before-known species of our collection 28 do not appear to be mentioned in any of the large collections of *Indian Crustacea* described by previous authors, and may therefore be regarded as new to the Indian fauna. These species are:—

1. *Hyastenus gracilirostris*, Miers.
2. *Hyastenus tenuicornis*, Pocock.
3. *Cryptopodia spatulifrons*, Miers.
4. *Lophozozymus nitidus*, Dana.
5. *Chlorodius lævissimus*, Dana.
6. *Chlorodopsis areolatus*, Edw.
7. *Cymo quadrilobatus*, Miers.
8. *Pilumnus cursor*, A. M.-Edw.
9. *Eriphia scabricula*, Dana.
10. *Carupa tenuipes*, Dana.
11. *Lupocyclus orientalis*, Miers.
12. *Lupocyclus rotundatus*, Ad. and Wh.
13. *Grapsus crinipes*, Dana.
14. *Plagusia clavimana*, Desm.
15. *Sesarma obesa*, Dana.
16. *Typhlocarcinus nudus*, Stimps.
17. *Typhlocarcinus villosus*, Stimps.
18. *Cryptosoma granulorum*, deHaan.
19. *Leucosia hæmatosticta*, Ad. and Wh.



20. *Leucosia obtusifrons*, deHaan.
21. *Arcania laevimana*, Bell.
22. *Arcania novem-spinosa*, Ad. and Wh., var. *aspera*, Miers.
23. *Phlyxia erosa*, A. M.-Edw.
24. *Myra darnleyensis*, Hasw.
25. *Myra elegans*, Bell.
26. *Nursilia dentata*, Bell.
27. *Iphiculus spongiosus*, Ad. and Wh.
28. *Cryptodromia conchifera*, Hasw.

2. LIST OF KNOWN SPECIES.

In the following list we have given references only to such species as are rare or new to the Indian fauna, and only such references as we have ourselves verified as aiding the discrimination of the species.

OXYRHYNCHA.

1. *Oncinopus neptunus*, Adams and White, North Maldive atoll, 20 fathoms.
2. *Doclea ovis*, Herbst, off Madras coast.
3. *Doclea muricata*, Herbst, Palk straits.
4. *Egeria indica*, Leach, off Madras coast, 20 fathoms.
5. *Chlorinoides aculeatus*, Edw., off Madras coast.
6. *Hyastenus aries*, Latr., off Madras coast.
7. *Hyastenus ? gracilirostris*, Miers, off Madras coast.

Described from Fiji, Ann. Mag. Nat. Hist., Vol. IV., 1879, p. 12.

8. *Hyastenus tenuicornis*, Pocock, off Ceylon, 30 fathoms.

Described from the China Sea, Ann. Mag. Nat. Hist., Vol. V., 1890, p. 76.

9. *Schizophrys spiniger*, Adams and White, off Madras coast.
10. *Micippe philyra*, Herbst, North Maldive atoll.
11. *Macrocoeloma* sp., off Colombo, 26½ fathoms.
12. *Lambrus calappoides*, Adams and White, off Colombo, 26½ fathoms.
13. *Lambrus carinatus*, Edw., off Madras coast.
14. *Lambrus contrarius*, Herbst, off Colombo, 26½ fathoms.
15. *Lambrus deflexifrons*, Miers, off Ceylon.

Described from Ceylon, Ann. Mag. Nat. Hist., Vol. IV., 1879, p. 21, pl. V. fig. 5.

16. *Lambrus echinatus*, Herbst, Palk Straits.
17. *Lambrus longimanus*, Leach, off Madras coast.
18. *Lambrus turriger*, Adams and White, off Madras coast.
19. *Cryptopodia fornicata*, Fabr., Palk Straits.
20. *Cryptopodia spatulifrons*, Miers, var. *laevimana*, Miers, Palk Straits.

Described from Australia and Borneo, Ann. Mag. Nat. Hist., Vol. IV., 1879, pp. 26 and 27, pl. V., fig. 10.

CYCLOMETOPA.

21. *Carpilius convexus*, Forsk., Laccadives.
22. *Carpilius maculatus*, L., Palk Straits.
23. *Lophozozymus nitidus*, Dana, Palk Straits.
Dana, U. S. Expl. Exp., Pt. I., p. 166, pl. VIII., fig. 4a, b.
24. *Actæa granulata*, Aud., Palk Straits.
25. *Actæa tomentosa*, Edw., Palk Straits.
26. *Xantho punctatus*, Edw., Palk Straits.
27. *Xanthodes notatus*, Dana, Palk Straits.
28. *Xanthodes lamarckii*, Edw., off Madras coast.
29. *Zozymus aeneus*, L., Laccadives.
30. *Daira perlata*, Herbst., Laccadives.
31. *Chlorodius laevissimus*, Dana. Palk Straits.
Dana, U. S. Expl. Exp., Pt. I., p. 215, pl. XII., figs. 4 a—g.
32. *Leptodius cavipes*, Dana, Palk Straits.
33. *Leptodius exaratus*, Edw., Palk Straits.
34. *Leptodius sanguineus*, Edw., Palk Straits.
35. *Chlorodopsis areolatus*, Edw. nec Ad. and Wh., Palk Straits.

For latest synonymy, see Miers, Zoology of H. M. S. 'Alert,' Crustacea, p. 532.

36. *Polycremnus octodes*, Herbst, off Madras coast.
37. *Etisus laevimanus*, Rand., Palk Straits. Laccadives.
38. *Phymodius unguatus*, Edw., off Madras coast.
39. *Cymo quadrilobatus*, Miers, Palk Straits.

Zoology of H. M. S. 'Alert,' p. 533.

We agree with Mr. Miers that this species is distinct from *C. andreossii*.

40. *Menippe rumphii*, Fabr., Laccadives.
41. *Actumnus setifer*, DeHaan, Palk Straits.
42. *Pilumnus andersoni*, de Man, Palk Straits.



43. *Pilumnus ? cursor*, A. M.-Edw., Palk Straits.

Described in Nouvelles Archives du Museum, Vol. IX., 1873, p. 244, pl. IX., fig. 4, from New Caledonia.

44. *Pilumnus vespertilio*, Fabr., Palk Straits.
 45. *Trapezia cymodoce*, Herbst., Palk Straits.
 46. *Trapezia digitalis*, Latr., Palk Straits.
 47. *Tetralia glaberrima*, Herbst., N. Maldive atoll, 15-30 fathoms.
 48. *Quadrella coronata*, Dana, off Ceylon, 28 fathoms.
 49. *Eriphia lævimana*, Latr., Laccadives.
 50. *Eriphia scabricula*, Dana, Palk Straits.

Dana, U. S. Expl. Exp., Crustacea, Part I., p. 247, pl. XIV., figs. 5a-b. For distribution see Miers, Zoology H. M. S. 'Alert,' pp. 535 and 572.

51. *Achelous granulatus*, Edw., off Colombo, 26½ fathoms.
 52. *Achelous whitei*, A. M.-Edw., Palk Straits.
 53. *Neptunus hastatoides*, Fabr., Palk Straits. Madras coast.
 54. *Neptunus sanguinolentus*, Herbst, off Madras coast.
 55. *Neptunus tuberculosus*, A. M.-Edw., Palk Straits.
 56. *Xiphonectes longispinosus*, Dana, N. Maldive atoll, 15-30 fathoms.
 57. *Thalamita admete*, Herbst, Palk Straits.
 58. *Thalamita prymna*, Herbst, Palk Straits.
 59. *Thalamita savignyi*, A. M.-Edw., Maldives. Palk Straits.
 60. *Goniosoma luciferum*, Fabr., deMan, Madras coast.
 61. *Goniosoma truncatum*, Fabr., deH., Palk Straits.
 62. *Goniosoma variegatum*, Fabr., var. *callianassa*, Herbst, Palk Straits.
 63. *Carupa tenuipes*, Dana, off Madras coast.

Dana, U. S. Expl. Exp. Crustacea. Pt. I., p. 279, pl. XVII., figs. 4a-e; and A. Milne-Edwards, Archiv. du Mus., Vol. X., p. 386, and Nouv. Archiv. du Mus., Vol. IX., 1873, p. 171.

64. *Lupocyclus orientalis*, Miers, off Madras coast, 33 fathoms.

Described from deep water, off Ki Islands and Admiralty Islands, 'Challenger' Brachyura, p. 186, pl. XVII., fig. 1.

65. *Lupocyclus rotundatus*, Adams and White, off Madras coast.

Adams and White, Voyage of H. M. S. 'Samarang,' Crustacea, p. 47, pl. XII., fig. 4. Borneo.

Our single specimen only differs from the above in one unimportant particular, namely, that instead of five spines on the anterior edge of the meropodite of the cheliped, as described by Adams and White, *loc. cit.*, and by deMan (Notes Leyden Museum, Vol. V., 1883, p. 153), there are seven. A. Milne-Edwards, however (Archiv. du Mus., Vol. X., 1861, p. 388), says "*environ cinq épines*," which would appear to show that the number is variable.

CATOMETOPA.

- 66. *Cardisoma carnifex*, Herbst, Pulicat, Madras coast.
- 67. *Ocypoda ceratophthalma*, Pall., Laccadives. Madras coast.
- 68. *Ocypoda cordimana*, Latr., Trincomallee. Madras coast.
- 69. *Ocypoda macrocera*, Edw., Ceylon coast. Madras coast.
- 70. *Ocypoda platytarsis*, Edw., Ceylon coast.
- 71. *Gelasimus annulipes*, Latr., Pulicat, Madras coast.
- 72. *Metopograpsus messor*, Forsk., Palk Straits.
- 73. *Grapsus crinipes*, Dana, Laccadives.

Dana, U. S. Expl. Exp., Crustacea, pt. i., p. 341., pl. XXI., figs. 6 a.-d.

- 74. *Grapsus pictus*, Latr., Laccadives. Ceylon.
- 75. *Grapsus strigosus*, Herbst, Trincomallee.
- 76. *Plagusia clavimana*, Desm., Madras coast.

Milne-Edwards, Hist., Nat., Crust., tom. II., p. 92, and Cuvier, Règne Animal, Crustacés, pl. 23., fig. 3.

- 77. *Plagusia depressa*, Herbst, Madras coast.
- 78. *Plagusia squamosa*, Lam., Palk Straits.
- 79. *Varuna litterata*, Fabr., Madras coast.
- 80. *Sesarma tetragona*, Fabr., Pulicat.
- 81. *Sesarma quadrata*, Fabr., Madras coast.
- 82. *Sesarma* ? *obesa*, Dana, Minnikoy.

Dana, U. S. Expl., Exp., Crustacea, pt. I, p. 356, pl. XXII., figs. 10a.-c. Str. of Balabac.

- 83. *Carcinoplax* sp. Madras coast.
- 84. *Notonyx* sp. Madras coast.
- 85. *Typhlocarcinus nudus*, Stimpson, Palk Straits.

Stimpson, Proc. Ac. Nat. Sci. Philad., 1858, p. 96, from Hong-kong.

- 86. *Typhlocarcinus villosus*, Stimpson, Palk Straits.

Stimpson, Proc. Ac. Nat. Sci. Philad., 1858, p. 96, from Hong-kong :
Miers, Proc. Zool. Soc., 1879, p. 40, from Corean and Japanese Seas :



Walker, Journ. Linn. Soc. Zool., Vol. XX., 1890, pl. IX., figs 6-8, from Singapore.

OXYSTOMATA.

87. *Calappa hepatica*, L., Laccadives. Maldives. Ceylon.

88. *Calappa lophos*, Herbst, off Madras coast.

89. *Cryptosoma granulorum*, deH., N. Maldive atoll.

deHaan, Fauna Japonica, Crustacea, p. 71, pl. XIX., fig. 3.

90. *Mursia bicristimana*, nob., Madras coast, 33 fathoms.

Vide Journ. Asiatic Soc. Bengal, pt. 2, 1894, p. 179.

The male differs from the female, (1) in its smaller size, (2) in its narrower rostrum, and (3) in its more closely and sharply granular integument.

91. *Matuta victrix*, Fabr., off Madras coast.

92. *Leucosia hæmatosticta*, Adams and White, off Madras coast.

Adams and White, Voyage, H. M. S. 'Samarang,' Crustacea, p. 54, pl. XII., fig. 2. "Eastern Seas." Also Walker, J. L. S., Zool., Vol. XX., 1890, p. 111, from Singapore: Miers, P. Z. S., 1879, p. 40, from Korean and Japanese Seas: Stimpson, Proc. Ac. Nat. Sci. Philad., 1858, p. 160, from Japan.

93. *Leucosia obtusifrons*, deH., off Madras coast.

deHaan, Fauna Japonica, Crustacea, p. 133, pl. XXXIII., fig. 2.

94. *Leucosia ornata*, Miers, off Trincomallee, 28 fathoms.

Miers, Trans. Lin. Soc., Zool., (ii) Vol. I., p. 236, pl., XXXVIII., figs. 7-9, from Ceylon. Dr. deMan, however, J. L. S., Zool., Vol. XXII., 1888, p. 197, regards this species only as a variety of *L. urania*, Herbst.

95. *Leucosia rhomboidalis*, deH., off Madras coast.

deHaan, Fauna Japonica, Crustacea, p. 134, pl. XXXIII., fig. 5. Already reported from Trincomallee, by F. Müller, Verh. Naturf. Ges. Basel, Band 8, 1890, p. 472.

96. *Leucosia urania*, Herbst, off Trincomallee, 28 fathoms.

97. *Arcania lævimana*, Bell, Maldives.

Bell, Trans. Linn. Soc., Zool., Vol. XXI., 1855, p. 310, pl. XXXIV., fig. 10, from Philippines. Also A. Milne-Edwards, Nouv. Archiv. du Mus., Vol. X., 1874, p. 48, pl. III., fig. 4, from New Caledonia.

98. *Arcania novemspinosa*, Adams and White, var. *aspera*, Miers, off Madras coast.

Miers, Ann. Mag. Nat. Hist., Vol. V., 1880, p. 317. "Malaysia."

99. *Ixa cylindrus*, Fabr. Palk Straits. Off Madras coast.

100. *Phylaxia erosa*, A. M.-Edw., Maldive atoll.



A. Milne-Edwards, *Nouv. Archiv. du Mus.*, Vol. X., 1874, p. 47, pl. III., fig. 2, from New Caledonia.

Also Miers, *P. Z. S.*, 1884, p. 13, from Mauritius, and from Fiji: and Haswell, *Cat. Australian Crustacea*, p. 125.

101. *Myra australis*, Haswell, off Madras coast.

102. *Myra darnleyensis*, Haswell, Maldives. Off Madras coast.

Haswell, *Proc. Linn. Soc. N. S. Wales*, Vol. IV., 1879, p. 52, pl. V., fig. 4. Australia.

103. *Myra elegans*, Bell, off Madras coast.

Bell, *Trans. Lin. Soc., Zool.*, Vol. XXI., 1855, p. 297, pl. XXXII., fig. 4. "In mari orientali."

104. *Myra fugax*, Fabr., off Madras coast.

105. *Pseudophilyra melita*, deMan, off Madras coast.

The granulation of the hand and upper surface of the carapace appears to be a secondary sexual character confined to males of large size.

106. *Nursea plicata*, Herbst, off Madras coast.

107. *Nursilia dentata*, Bell, Maldives. Off Madras coast.

Bell, *Trans. Lin. Soc., Zool.*, Vol. XXI., 1855, p. 309, pl. XXXIV., fig. 6. "In oceano Indico." Also Stimpson, *Proc. Ac. Nat. Sci. Philad.*, 1858, p. 161, from E. Pacific Ocean: Haswell, *Proc. Linn. Soc., N. S. Wales*, Vol. IV., 1879, pp. 56 and 104, from Australian Region: Miers *Zoology, H. M. S., 'Alert,' Crustacea*, pp. 253 and 548, from Australia Arafura Sea, Fiji, Seychelles: Pocock, *Ann. Mag. Nat. Hist.*, Vol. V., 1890, p. 73, from China Sea, 40 fathoms.

108. *Iphiculus spongiosus*, Adams and White, off Madras coast.

Adams and White, *Voyage H. M. S. 'Samarang,' Crustacea*, p. 57. Philippines. Also Stimpson, *Proc. Ac. Nat. Sci. Philad.*, 1858, p. 161, from Hong-kong: Miers, *Zoology H. M. S., 'Alert,' Crustacea*, p. 253, from the Arafura Sea, 32-36 fms.

109. *Dorippe quadridens*, Fabr., off Madras coast.

110. *Dorippe sima*, Edw., Palk Straits.

111. *Cymopolia jukesii*, White., N. Maldiva atoll.

We place this species here, though we share Mr. Miers' doubt ('Challenger,' *Brachyura*, p. 334) as to its having any very near connexion with the *Dorippidæ*. We think that it is probably a *Catome-*tope, and that it should be placed near the *Gonoplacidæ*, as delimited by Dana.



ANOMALA.

112. *Cryptodromia ?conchifera*, Haswell, off Madras coast.

Haswell, Cat. Australian Crustacea, p. 141, pl. III., fig. 4.

113. *Raninoides serratifrons*, Henderson, off Trincomallee, 28 fathoms.

Henderson, Trans. Lin. Soc., Zool., 1893, p. 408, pl. XXXVIII., figs. 10-12.

3. DESCRIPTIONS OF NEW SPECIES.

OXYRHYNCHA.

ACHÆUS, Leach, Miers.

114. *Achæus hyalinus*, n. sp.

Carapace subtriangular, thin, vitreous, spiny, the regions fairly well defined, the postorbital region constricted.

The spiny rostrum, as seen from above, ends in two short spines,* each of which is bifid from the base; but, as seen from below, these spines do not form the end of the rostrum, which is now seen to consist of a strong vertically deflexed spine united by a flying bridge to the interantennular septum.

The inflated gastric and branchial regions, as well as the hepatic regions and the antero-lateral border of the carapace, are coarsely, sharply, and rather distantly spiny, most of the spines being capped with a tuft of short hairs.

The eyes are movable but not retractile, and the eye-peduncle has a tubercle in the middle of its anterior surface.

All the ambulatory legs are hairy throughout, the hairs of those of the 2nd and 3rd pairs being remarkably long, close-set, even and stiff. The arm, wrist, and hand of the chelipeds are acutely spiny, as are also the edges of the meropodites of the 2nd-5th legs, the spines on the front edge of the meropodites of the 2nd and 3rd pairs being particularly large and conspicuous.

The 5th pair of legs is subcheliform, the propodite being remarkably dilated at its base to receive the tip of the claw-like dactylus: the dactylus is minutely spinate, but the expanded base of the propodite is furnished with a comb of sharp spines.

Length of carapace 14 millim., breadth of carapace 9 millim. greatest span 67 millim.

Off Trincomallee, 28 fathoms.

* These spines are very short and divergent, and are nothing like those of *Stenothynchus*.



INACHOIDES, Edw. and Lucas.

Milne-Edwards and Lucas, in D'Orbigny, Voy. dans l'Amer. merid., Crustacés, pp. 4-5.

Miers, Journ. Linn. Soc., Zool., vol. XIV., 1879, p. 646.

A. Milne-Edwards, Miss. Sci. au Mexique etc., I, Crustacés etc., p. 198.

115. *Inachoides dolichorhynchus*, n. sp.

Distinguished by its rostrum, which is equal in length to the rest of the carapace.

Excepting the rostrum, the form of the body is very similar to that of the type species (Milne-Edwards and Lucas, *op. cit.*, pl. iv., fig. 2.)

The long curved simple rostrum, and the carapace, are spiny: the regions of the carapace are well delimited: the supra-ocular and post-ocular spines, though small, are distinct. In addition to spinules there are numerous larger spines—four on the gastric region, a bicuspid one on the cardiac region, one on the intestinal, and about four on each branchial.

The eyes are retractile towards the sides of the carapace, but are in all positions *completely* exposed.

The chelipeds are about one-fourth longer than the carapace rostrum included; their palm, which is about two-fifths of their total extent and nearly three times the length of the fingers, is broadened and moderately inflated.

The other legs in form and proportion resemble those of the type (Edw. and Lucas, *op. cit.*, pl. iv., fig. 2).

Total length of carapace, 17.5 millim.; greatest breadth of carapace, 8 millim.; greatest span 54 millim.

Off Madras coast, shallow-water.

The genus *Inachoides* though recorded from Viti, by M. A. Milne-Edwards (Journ. Mus. Godeffroy, vol. i., 1873-74, p. 253), does not appear to have been before observed in Indian waters.

OXYSTOMATA.

ARCANIA, Leach, Miers.

116. *Arcania quinquespina*, n. sp.

Only differs from the well-known *Arcania septemspina* (which, though not contained in the present collection, is very common in shallow water off the Madras coast) in the following particulars.—

(1) the great spines of the carapace are relatively smaller, and



the spine on the posterior part of the branchial region—on either side of the intestinal region—is altogether wanting ;

(2) the lobes of the rostrum are longer and more acute ;

(3) the fingers, instead of being equal in length to the palm, are nearly twice the length of the palm ;

(4) the small cardiac region is of a bright-red colour, edged with white, and this can be seen fairly well even after prolonged immersion in strong spirit.

In all other respects this species exactly resembles *Arcania septemspinosa*, Fabr.

Off Madras coast, up to 13 fathoms.

LEUCOSILIA, Bell.

117. *Leucosilia granulosa*, n. sp.

Carapace slightly broader than long, subglobose: truncated anteriorly, so that the external maxillipeds are visible beyond the front: very closely covered, as are also the chelipeds, with bead-like granulations: the regions delimited by shallow yet distinct furrows. The rostrum consists of two divergent hollow lobes, beneath which the antennules are lodged: immediately behind the rostrum the carapace is traversed from side to side by a deep groove. The antero-lateral margin is interrupted by a deep notch, in front of which is a coarse blunt hepatic tooth, while behind it is a stronger epibranchial tooth. The lateral angle is also marked by a prominent granule. The posterior margin is almost straight and bears three tubercles, of which the median is hardly conspicuous. The hepatic regions are inflated, as are also the sides of the gastric region. The intestinal region forms a tumid boss, on the summit of which the granulations are obsolescent.

The tips of both rami of the external maxillipeds are strongly bent upwards, that of the exognath ending in a large blister-like tubercle. The spine on the penultimate abdominal segment of the male is a mere tumescence.

A male and an egg-laden female from the North Maldivé atoll, 15-30 fathoms.

	Male.		Female.
Length of carapace.....	6.5	millim	7.5 millim.
Breadth of carapace	7.0	millim.	9.0 millim.
Greatest span (of chelipeds).....	24.0	millim.	26.5 millim.

Besides being smaller, and having the chelipeds of slightly greater relative length, the male differs from the female in being much more sharply granular.



DORIPPE, Fabr., Edw.

118. *Dorippe polita*, n. sp.

Apparently nearest to *Dorippe sexdentata*, Stimpson, Proc. Acad. Sci. Philad., 1858, p. 163, from South Japan.

Distinguished by the smooth, hard, naked, and polished integument of the body and limbs.

Carapace smooth and polished, slightly broader than long, with the regions hardly defined.

Front divided into four small lobes, of which the two median, though slightly the smaller, are slightly the more prominent, and also arise on a lower level.

The external orbital angles are a little more prominent than the front. Infra-orbital tooth blunt, small, and inconspicuous.

The lateral borders of the carapace are faintly notched near the middle, being sharp, almost straight, and convergent in front of the notch, and a little inflated behind it.

The sterna between the chelæ are remarkably tumid.

The eye-stalks are long, slender, and much curved.

The legs are perfectly smooth, and, except for some scanty hairs on the chelipeds, are naked: the last four pairs are flat, and the last two pairs typically subchelate. The pleuræ, or plates beneath which the fifth pair of legs arise, are remarkably large.

Length of carapace, about 11.5 millim., greatest breadth of carapace about 12 millim., greatest span (3rd pair of legs) 61 millim.

A single egg-laden female from off the Madras coast, 7 fathoms.

In many respects this species resembles *Ethusa* much more closely than *Dorippe*; but the disposition of the afferent branchial opening proves it to be a true *Dorippe*.

? CATOMETOPA.

CYMOPOLIA, Roux, Edw.

119. *Cymopolia serripes*, n. sp.

This species is characterized by the broadly expanded lamellar (natatory) propodites and dactyli of the third and fourth pairs of legs, and by the sharp serration of the posterior edges of those joints.

The carapace is of the usual form, with the regions plainly delimited, and the surface very crisply granular. The front is four-lobed, the outer lobe on either side being inconspicuous and recurved upwards at tip, the two middle lobes being conspicuous and deflexed. The supra-orbital margin is serrated and folded much as in *O. caronii*.

The antero-lateral margins have, exclusive of the large external



orbital tooth, four sharp teeth, which increase in size from behind forwards.

The sinuous postero-lateral margins are quite smoothly moulded.

The posterior margin is surmounted by a festoon of eight even teeth, much as in *C. caronii*; below it the last—and only the last—sternal segment is produced to form a remarkably sharp and salient crest, much more salient than that, for example, of *C. caronii*.

The trunk-legs of the second pair are not longer, and, except in their meropodite, hardly stouter than those of the fifth pair: their propodite is sharply and finely serrated along its posterior border, and their claw-like dactylus has at its base, on the same border, two sharp teeth.

The trunk-legs of the third and fourth pair resemble each other in form and size, their length being about one-fifth more than the greatest breadth of the carapace: their prismatic meropodites are short, inflated, and considerably more than half as broad as long, with the edges sharply denticulate, and with the upper surface crisply granular: their carpopodites, though distinctly prismatic, with all the edges sharply delimited, are much depressed, and have the anterior, posterior, and distal borders all sharply denticulate: their propodites and dactyli are broadly lamellar and distinctly natatory, the swimming surface being increased by a thick fringe of very long setæ on the anterior border: both these joints are longitudinally ribbed and fluted, and both have the posterior border sharply serrated.

The legs of the fifth pair are filiform: their length is about two-thirds the greatest breadth of the carapace: they are finely granular above, and their dactylus is as long as their propodus.

Colours in spirit, mottled shades of white and purplish brown, with broad cross-bands on the propodites and dactyli of the third and fourth pairs of legs.

Length of carapace 9·5 millim., breadth of carapace 11 millim. greatest span (fourth pair of legs) 37 millim.

Off Madras coast, shallow water

Postscript. We take the present opportunity of noticing an omission in the Plate (Plate IX) illustrating *Archæoplax notopus*, nob.* A figure of the external maxillipeds has been inadvertently left out.

* J. A. S. B., Part ii., No. 3, 1894, pp. 181-183, Plate ix.

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OF THE

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fuscous; the outer margin bears a narrow black line, then a waved narrow ochreous (in some specimens violet) line, then a nearly straight ochreous (or violet) line, the extreme margin narrowly black. *Forewing* with the apex washed with ochreous; a subapical black ocellus, sometimes with a second smaller one attached to it posteriorly, and a



JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.



Vol. LXIII. Part II.—NATURAL SCIENCE.

No. I.—1894.

I.—*On new or little-known Butterflies from the Indo-Malayan region.*—
By LIONEL DE NICEVILLE, F. E. S., C. M. Z. S., &c.

(With Plates I, II, III, IV and V.)

[Received February 10th ;—Read March 7th, 1894.]

Family NYMPHALIDÆ.

Subfamily SATYRINÆ.

1. MYCALESIS (*Satoa*) MALA, n. sp., Plate I, Figs. 1, ♂; 2, ♀.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♂, 1·8 to 1·9; ♀, 2·1 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* black, glossed with vinous in some lights; a narrow waved marginal line. *Forewing* with the costa, apex broadly, and outer margin decreasingly paler; a small black white-pupilled ocellus in the anterior discoidal interspace, sometimes with a smaller ocellus attached to it posteriorly; a large round black spot in the first median interspace, outwardly bounded by a pale line. *Hindwing* with a broad whitish patch on the costa at the base of the wing; the outer margin narrowly pale. UNDERSIDE, *both wings* fuscous; the outer margin bears a narrow waved black line, then a waved narrow ochreous (in some specimens violet) line, then a nearly straight ochreous (or violet) line, the extreme margin narrowly black. *Forewing* with the apex washed with ochreous; a subapical black ocellus, sometimes with a second smaller one attached to it posteriorly, and a

very large posterior ocellus, these ocelli have a white pupil, the black portion surrounded by an ochreous, a black, and lastly a violet ring; the inner margin broadly whitish. *Hindwing* with a basal nearly straight and a discal irregular violet fascia; a series of seven ocelli towards the margin similar to those on the forewing, but the outer rings of all of them joined and forming a continuous violet bordering to the whole series of ocelli, the first, fourth and sixth ocelli of medium size, the second, third and seventh small, the fifth the largest. FEMALE. *UPPERSIDE*, both wings much paler than in the male. *Forewing* with an indistinct subapical broad dull ferruginous fascia, reaching from the costa to the first median nervule; otherwise similar to the male, except that all the secondary sexual characters found in the male are wanting.

Nearest to *M. maianeas*, Hewitson, the only other species in the subgenus *Satoa*; described by Hewitson from Malacca [?] and Sarawak, of which the female has alone been figured, and from which the same sex of *M. maia* appears to differ in having a subapical ocellus on the upperside of the forewing, and the "orange band" instead of being very richly coloured and prominent is reduced to an obscure cloud on both surfaces.

This species appears to occur not uncommonly in the mountains of N.-E. Sumatra, and there are numerous specimens in Dr. Martin's collection as well as in my own. I possess specimens taken in July and December. Both Mr. Henley Grose Smith ("Head Hunters of Borneo"), and Dr. B. Hagen ("Die Pflanzen- und Thierwelt von Deli auf Der Ostküste Sumatra's") record *M. maianeas*, Hewitson, from Sumatra, but this species is probably the one meant.

Subfamily MORPHINÆ.

2. STICHOPHTHALMA SPARTA, n. sp., Plate I, Fig. 4, ♂.

HABITAT: Manipur.

EXPANSE: ♂, 5.0 inches.

DESCRIPTION: MALE. *UPPERSIDE*, both wings deep rich reddish-fulvous or ferruginous. *Forewing* with the irregular discal black line of the underside shewing through by transparency; the apical area widely pale fulvous, this pale area extends from the submarginal hastate black markings to just within the discal black line, it is very wide on the costa, but dies away to nothing before reaching the first median nervule; a series of five submarginal hastate black markings, one in each interspace from the upper discoidal nervule to the submedian nervule, increasing progressively in size from the anterior to the posterior marking; a large black patch at the apex; a submarginal fulvous line, beyond which is a narrower anteciliary black line, both

reaching from the inner angle to the lower discoidal nervule; the area enclosed by the coalescing of the hastate markings forms a series of six rounded spots regularly increasing in size, the anterior spot the smallest, the posterior one the largest, these spots are of a slightly darker shade than the pale fulvous apical area, but not so dark as the dark, rich reddish-fulvous of the rest of the wing. *Hindwing* with the abdominal and outer margins rather paler than the rest of the wing; a submarginal series of seven black markings, of which the anterior one is a small lunule with its concave edge directed towards the base of the wing, the next five markings are hastate-shaped,* increasing in size from the anterior one to the posterior one in the first median interspace, the seventh posterior marking somewhat quadrate in form, and occupying the whole width of the submedian interspace; a fine black anteciliary thread. *UNDERSIDE*, *both wings* of a reddish-fulvous of not quite so rich a shade as on the upperside. *Forewing* with a small irregular black marking towards the base of the cell; a highly irregular and ziz-zag black line crosses the middle of the cell and extends both to the costa and to the submedian nervure, the posterior portion of the line is broken and shifted outwardly below the median nervure; the upper, middle, and anterior half of the lower disco-cellular nervule defined by a black line; an irregular discal black line from the costa to the submedian nervure, just touching the lower end of the cell; beyond the line is a series of five somewhat cordate, reddish ocelli, each ocellus centred with a whitish lunule and bounded by a fine whitish and then a fine black line, the four anterior ocelli equal-sized, the fifth posterior one in the first median interspace a little larger; beyond these ocelli is another irregular black line from the costa to the inner margin, this line is narrower and paler than the discal one; the space between these two lines is anteriorly somewhat paler than the rest of the wing; a submarginal nebulous straight blackish band; a very fine anteciliary black line. *Hindwing* with an irregular sub-basal and a discal black line, the latter posteriorly curving round and almost meeting the posterior end of the former, both terminating above the anal angle on the submedian nervure; a series of five ocelli on the disc similar to those in the forewing, the posterior one the largest and rather misshapen, the anterior one the next largest, the three in the middle nearly equal sized; the outer discal fulvous line and

* The late Professor J. O. Westwood well described these peculiar and characteristic markings of the genus *Stichophthalma* as being built up of a much curved lunule on the margin coalescing inwardly with a spear-shaped spot. To me these markings have a curious likeness to the black silhouette of the head and shoulders of a human figure, especially the third marking from the anal angle of the hindwing in the specimen here figured.

blackish submarginal band as in the forewing; a small oval deep black spot at the anal angle, with a black cloud above it reaching to the posterior ocellus; an anteciliary black thread. *Antennæ* black. *Body* throughout ferruginous.

Nearest to *S. howqua*, Westwood, var. *suffusa*, Leech,* from Western China, differing in the forewing on the upperside in the pale apical area being very much smaller, not extending into the cell as it does in *S. howqua*, var. *suffusa*; on the hindwing the hastate markings in *S. sparta* are well formed, in Mr. Leech's species they have lost all shape, having coalesced into an almost solid black band. On the underside the ground-colour in *S. howqua*, var. *suffusa* is pale greenish, in *S. sparta* it is ferruginous, but this may be only a sexual difference; but in true *S. howqua* and its named variety the outer discal line and the submarginal band on both wings are half the distance apart that they are in *S. sparta*; and they have six and sometimes seven ocelli on the forewing, while *S. sparta* has only five.

Described from a single example purchased from a telegraph signaller employed at Manipur.

Subfamily NYMPHALINÆ.

3. HERONA PRINGONDANI, Fruhstorfer, Plate III, Figs. 5, ♂; 4, ♀.

H. pringondani, Fruhstorfer, Ent. Nach., vol. xix, p. 314 (1893).

HABITAT: Java.

EXPANSE: ♂, 2·9; ♀, 2·9 to 3·1 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* dull brown, slightly tinged with ochreous. *Forewing* with an indistinct pale oblique band across the end of the discoidal cell; a broad very irregular discal white band extending across the wing, divided into oblong spots by the brown veins crossing it, the four anterior portions from the costa to the third median nervule are placed outwardly obliquely, the first portion on the costa is very small, the second is larger, the third is the largest, the fourth not quite so long as the third but broader; the four remaining portions of the band are placed parallel to the outer margin, the upper portion in the second median interspace is oval in shape, the second portion is the largest of all and has a small round black spot in its middle, the third is smaller than the second but bears a large round black spot, the posteriormost portion on the inner margin is short; two subapical crescent-shaped white spots placed obliquely, divided by the upper discoidal nervule. *Hindwing* with a broad even discal white band extending from the costa to near the abdominal margin,

* Butt. from China, Japan, and Corea, p. 114, pl. i, fig. 8, female (1892).

divided by a highly irregular blackish fascia which is broken at the third median nervule; an indistinct ochreous cloud across and beyond the end of the cell; some whitish spots on the margin towards the apex. **UNDERSIDE**, *both wings* with a highly irregular narrow discal brown line extending across the surface, commencing above the anal angle of the hindwing and ending in a rather broad dark fascia at the costa of the forewing. *Forewing* whitish, the inner margin very broadly extending half way across the discoidal cell pale ochreous; an oblique brown band across the middle of the cell, a short one at the end of the cell; the white band of the upperside indistinctly defined, but the two black spots divided by the first median nervule distinct but smaller than on the upperside. *Hindwing* whitish mottled and clouded with pale ochreous-brown; an oval conspicuous brown spot in the middle of the cell placed against the subcostal nervure. **FEMALE** shaped and marked precisely as in the male, and can only be distinguished therefrom by the stouter abdomen and the structure of the forelegs.

Nearest to *H. schoenbergi*, Standinger,* from South-East Borneo, from which it appears to differ in the forewing in the discal white band being broader and continuous throughout, in *H. schoenbergi* it is broken up into a double series of spots, the outer series is white, the inner pale ochreous; in the hindwing the discal white band in *H. pringondani* is placed much farther from the outer margin than in *H. schoenbergi*, and the black fascia it bears is strongly broken and dislocated in the middle, while in *H. schoenbergi* the white discal band approaches much nearer the margin, and the black fascia across the band is continuous throughout and divides the band nearly equally; lastly, there is a small round black spot in the middle of the first median interspace in *H. schoenbergi* which is wholly wanting in *H. pringondani*.

Described from one male and two females received from Mr. H. Frubstorfer, to whose courtesy I am indebted for a copy of his description of the species, which reached me just in time to enable me to substitute his name for the one I had proposed for this interesting *Herona*.

4. *HERONA SUMATRANA*, Moore, Plate III, Fig. 7, ♀.

H. sumatrana, Moore, Trans. Ent. Soc. Lond., 1881, p. 308.

HABITAT: N.-E. Sumatra.

EXPANSE: ♂, 3.0 to 3.1; ♀, 3.1 to 3.4 inches.

* *Herona schoenbergi*, Standinger, Iris, vol. iii, p. 337, n. 3, pl. iii, fig. 3 (1890); vol. iv, p. 84 (1891). The figure is probably taken from a female specimen. This may be the species referred to by Mr. W. Doherty in Journ. A. S. B., vol. lviii, pt. 2, p. 122 (1889) thus:—" *Euthalia (Felderia) macnairi*, Distant, is mimicked by a new and remarkable species of *Herona* (?) of which both sexes were taken by me in Borneo, and are now in Mr. Neumoegen's possession."

DESCRIPTION: MALE. UPPERSIDE, *both wings* dull brown, slightly tinged with ochreous. *Forewing* with a discal macular band consisting of seven separated portions, the four anterior ones elongated, whitish, dusted with fuscous, the three posterior ones rounded, white, tinted with violet in some lights; three subapical small violet-white spots arranged in an equilateral triangle, with the apex of the triangle towards the outer margin of the wing; a large quadrate ochreous spot in the first median interspace within the discal band, a smaller one in the submedian interspace bisected by the internervular fold, a narrow streak on the inner margin. *Hindwing* with a broad even discal white band, strongly tinted with violet in some lights, extending from the costa to near the abdominal margin, divided by a highly irregular fascia, anteriorly fuscous, posteriorly broader and paler, the fascia broken at the third median nervule; a complete marginal series of whitish spots between the veins. UNDERSIDE, *both wings* marked and coloured almost exactly as in *H. pringondani*, Fruhstorfer, from Java. FEMALE, as in the male, but the violet suffusion of the upperside rather more prominent.

Closely allied to *H. schoenbergeri*, Staudinger, from South-East Borneo, and to *H. pringondani*. It differs from both in the violet reflections of the upperside; it agrees with the latter in the fuscous fascia of the hindwing on the upperside placed on the discal white band being strongly broken and dislocated in the middle, thereby differing from the former. The markings of the forewing differ a good deal in detail in *H. pringondani* and *H. sumatrana*, as will be noted by a reference to the figures and descriptions of the two species.

Described from two males and three females in Dr. Martin's and my collection, one of which was taken in the virgin forest at Selesseh in September. It may be a mimic of the common species of *Euthalia* (*Felderia*) of the group of *cocytina*, Horsfield.

5. NEPTIS CLINIODES, n. sp., Plate I, Fig. 8, ♂.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♂, ♀, 2.2 inches.

DESCRIPTION: MALE and FEMALE. UPPERSIDE, *both wings* deep black, markings creamy-white. *Forewing* with the discoidal streak wide, joined to the triangular spot beyond, just "nicked" or indented anteriorly at the end of the cell; the discal series consists of seven spots, placed in two groups, the upper of three, the lower of four spots, the groups well separated, the uppermost spot very small, linear, the two following large, conjoined, divided only by the upper discoidal nervule, the four posterior spots large, contiguous; the submarginal macular line obsolete in the male, composed of small linear streaks in the female.

Hindwing with a broad discal band, widest on the costa, gradually and evenly tapering to the abdominal margin; the submarginal band composed of prominent narrow portions; an indistinct pale line between the discal and submarginal bands; a similar marginal line. *UNDERSIDE*, both wings reddish-brown, all the markings broader than on the upper-side. *Forewing* with three marginal lines, the inner one very narrow, the middle one the broadest; on the margin are two white spots divided by the lower discoidal nervule, and two others divided by the first median nervule. *Hindwing* with a short basal streak on the costa, behind which is a longer curved one running into the discal band; between the discal and submarginal bands is a narrow straight line; two lines on the margin, the outer one the broader.

Perhaps nearest to *N. clinia*, Moore,* from Bengal (*Moore*) and Siam (*Druce*), known to me by the figure and description only, from which it appears to differ in having the discoidal streak and spot beyond in the forewing joined instead of separated, the discal spots larger, the discal band on the hindwing narrower, tapering, instead of being of equal width throughout; the submarginal band creamy-white like the other markings instead of being "brownish-white." From the figure of *N. nandina*, Moore, it differs in the discoidal streak and spot beyond of the forewing being continuous; the discal series of spots seven in number instead of six, they are also larger and conjoined instead of being well separated; the markings of the hindwing on both surfaces very similar.

Described from two examples in my collection, taken in June; there are numerous examples in Dr. Martin's collection.

6. *NEPTIS NISÆA*, n. sp., Plate I, Fig. 9, ♂.

HABITAT: Java.

EXPANSE: ♂, 1.3 inches.

DESCRIPTION: *MALE*. *UPPERSIDE*, both wings deep black with pure white markings. *Forewing* with a narrow streak in the discoidal cell well separated from the triangular spot beyond; the discal series consists of six spots, placed in pairs, each pair conjoined, divided only by the crossing vein; a submarginal series of small linear spots more or less obsolete about the third median nervule. *Hindwing* with the discal band narrow on the abdominal margin gradually and regularly increasing in width to the costa; the submarginal band consists of six very narrow well separated spots; there is also an extremely faint line between the discal and submarginal bands, and a similar marginal line. *UNDERSIDE*, both wings chocolate-brown with pure white markings. *Forewing* with the inner margin broadly fuscous; the discoidal streak

* *Proc. Zool. Soc. Lond.*, 1872, p. 563, pl. xxxii, fig. 5, male.

very wide; the anterior pair of spots of the discal series continued to the costa; the margin bears three interrupted series of spots. *Hind-wing* with a costal band at the base of the wing; an obscure grey fascia posterior to this; the discal band very narrow on the abdominal margin, very broad on the costa; followed by a grey line; the spots of the submarginal band wider and more lunular than above; two prominent marginal lines, the outer the wider.

It is difficult to say to what group *N. nisæa* belongs. The discal band of the forewing being divided into three pairs of spots allies it to the *N. columella* group, the pure white markings and general *facies* ally it to the *N. nata* group. It is also near to *N. nandina*, Moore, originally described from Java and Darjeeling, but the middle pair of spots of the discal series on the forewing being conjoined instead of well separated will immediately differentiate between the two species. On the whole it appears to be nearest to *N. pampanga*, Felder, from N.-W. Luzon, as figured in Herr Georg Semper's "Schmett. der Philippinischen Inseln," pl. xxix, figs. 6, *male*; 7, *female*, from which it may instantly be known by the discal band of the hindwing on the underside being half the width at the point where it touches the abdominal margin that it is in that species.

Described from two examples received from Herr H. Fruhstorfer.

7. ARGYNNIS NIPHE, Linnæus, Plate III, Figs. 1 and 2.

The gynandromorphous example of *A. niphe*, Linnæus, here figured was reared by Mrs. S. Robson at Bankipur, Behar, Northern India, and emerged from the pupa on the 2nd March, 1893. It is thus referred to* by that lady in describing her experiments in breeding this species:—"One *lusus naturæ*, a male, had one wing as in the ordinary male, and the other as in the ordinary female!"

This insect has the right-hand pair of wings masculine, the left-hand pair feminine. In the masculine half of the insect there is, however, in the forewing on the upperside a slight admixture of feminine coloration, the round black spot in the lower discoidal interspace in the outer discal series of spots has a streak of white on either side of it, and on the disc are many irregular blue-black streaks more or less connecting the black spots. The hindwing is quite normal. On the underside of the masculine forewing there is the commencement of a well-defined white subapical band as in a normal female example, and the discal black spots have, as on the upperside, some irregular blue-black markings attached to them. The hindwing on the underside is quite normal. The feminine pair of wings are smaller than the mascu-

* Journ. Bombay Nat. Hist. Soc., vol. viii, p. 152 (1893).

line pair, and have all the markings and coloration of an ordinary female. The masculine antenna is 14 mm. in length; the feminine is much shorter, being only 10.5 mm. in length. Externally the organs of generation are masculine, I have not dissected them to ascertain their internal structure.

Gynandromorphous butterflies are very rare. In all my experience I have met with only one other example in India, a specimen of *Cyllogenes suradeva*, Moore, collected by the late Mr. Otto Möller, and now in Mr. J. H. Leech's possession. The late Professor Westwood has figured two separate examples of *Cirrhochroa aoris*, Doubleday and Hewitson; Mr. George T. Baker has figured and described the primary sexual characters of an *Eronia* (*Nepheronia*) *hippia*, var. *gæa*, Felder, and Herr Georg Semper an example of *Papilio castor*, Westwood, these are the only other Indian gynandromorphous butterflies of which I am aware.

8. EUTHALIA SAKII, n. sp., Plate III, Fig. 3, ♀.

HABITAT: N.-E. Sumatra.

EXPANSE: ♀, 3.1 inches.

DESCRIPTION: FEMALE. UPPERSIDE, both wings pale ochreous-brown. Forewing with a narrow fuscous line crossing the discoidal cell near the base, continued to the submedian nervure; a large ring-spot in the middle and another at the end of the discoidal cell; a series of five semi-transparent sullied-white spots between the veins beyond the end of the cell, from the subcostal nervure to the first median nervule; the anteriormost spot linear; the second also linear, but a little longer than the first; the third spot triangular, the smallest of the three, the fourth spot larger than the third, cordate; the fifth the largest of all, also cordate; beyond this series of spots is a broad irregular diffused violet-whitish-powdery fascia, narrow at the costa, wide on the inner margin, bearing a series of dark sagittate markings placed between the veins from the lower discoidal nervule to the submedian nervure; a very small fuscous ring-spot in the submedian interspace placed at the point where the first median nervule originates. Hindwing with a small fuscous spot in the middle of, and a much larger ring-spot closing the cell; a discal series of six spots similar to and in continuation of the series in the forewing, the three anterior ones large, cordiform, decreasing in size, placed in the costal, upper and lower subcostal interspaces, the fourth spot in the discoidal interspace almost obsolete and very small, the fifth and sixth spots in the median interspaces small; the outer margin broadly whitish washed with a metallic greenish-blue of a curious shade, and bearing a prominent

dentated dark line in its middle. **UNDERSIDE**, both wings pale ochreous, all the markings similar to those on the upperside but much more prominent. *Hindwing* with the usual markings in and around the discoidal cell, otherwise as on the upperside. *Body* above and below concolorous with the wings. *Legs* pale ochreous.

E. sakii is perhaps nearest to *E. merta*, Moore, described from China, a female of which I possess from Quang in the Malay Peninsula, but it differs in the discal series of five spots in the forewing having their outer ends more or less excavated, while in *E. merta* the exact reverse obtains, each spot being produced outwardly into a sharp point. In *E. sakii* the sagittate markings beyond the discal series of spots also in the forewing have their apices directed towards the base of the wing, in *E. merta* towards the outer margin. On the hindwing in *E. sakii* the submarginal dentated dark line is continuous, in *E. merta* it is replaced by a series of well-separated small round spots, and there are other minor differences between the two species.

Described from a single example in Dr. L. Martin's collection. I have named it after Saki, a highly intelligent Javan collector in Dr. Martin's service.

9. *EUTHALIA (Dophla) IVA*, Moore.

Adolias iva, Moore, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 195, n. 395 (1857); idem, id., Trans. Ent. Soc. Lond., new (second) series, vol. v, p. 78, n. 36, pl. viii, fig. 2, male (1859); id., Butler, Proc. Zool. Soc. Lond., 1868, p. 602, n. 14; *Euthalia iva*, de Nicéville, Butt. of India, vol. ii, p. 197, n. 491 (1886).

HABITAT: Darjeeling (Moore); Manipur.

EXPANSE: ♀, 4.5 inches.

DESCRIPTION: FEMALE. Differs from the male only in being somewhat larger, the forewing rather more elongated.

I have recently been so fortunate as to acquire by purchase a pair of specimens of this fine species. It was described as far back as 1857 by Mr. Moore from Darjeeling. I am a little doubtful regarding this locality, as it is strange that within recent years this large species should not have been obtained in the Sikkim district, which is for butterflies perhaps the most completely explored of any in India. However, it may have occurred there in the middle of the century, and since become exterminated, as has its near ally, *E. durga*, Moore, owing to the enormous destruction of the virgin forests that has taken place for the cultivation of tea. *E. iva* comes into the group of *E. patala*, Kollar, *E. durga*, Moore, and *E. duda*, Standinger, in which the sexes are very much alike, in that respect differing from *E. nara*, Moore, and *E. sahadeva*, Moore, in which the sexes differ greatly, the females of these two



species being like both sexes of the former group.* My male specimen agrees very well with Mr. Moore's figure of the same sex, differing only in the lowest white streak of the discal series in the first median interspace in the forewing being slightly less elongated, and the spot in the middle of the submedian interspace of that wing being outwardly cleft only, instead of being completely separated into two spots.

10. EUTHALIA (*Dophla*) EION, n. sp., Plate III, Figs. 8, ♂; 6, ♀.

HABITAT: Java.

EXPANSE: ♂, 2·8; ♀, 3·2 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* fuscous, crossed by a common macular discal pale greenish-yellow band. *Forewing*, the band consists of seven well-separated spots, gradually increasing in size from the costal to the inner margin, the uppermost spot a little out of line with the rest, shifted inwardly towards the base of the wing, the spots all more or less rounded, the one in the submedian interspace cleft outwardly; a very small white subapical spot; a submarginal series of increasing obscure black spots placed between the veins. *Hindwing*, the discal band consists of eight conjoined spots, the three uppermost pure white, each spot has its inner edge rounded, its outer edge brought to a point in the middle; a submarginal obscure black fascia, beyond which is a decreasing series of seven small round white spots, one in each interspace. UNDERSIDE, *both wings* pale brown, glossed throughout with violet; the common discal band much as above. *Forewing* with a black ring-spot centred with crimson in the middle of the discoidal cell, a crimson line placed on the disco-cellular nervules, defined on both sides by a black line; some obscure linear black spots placed between the veins midway between the discal band and the outer margin. *Hindwing* with a very small black ring-spot in the middle of the cell, a black line on either side of the disco-cellular nervules, a submarginal series of linear black spots much as in the forewing. FEMALE. UPPERSIDE, *both wings* much paler than in the male, the disco-cellular markings shewing through. *Forewing* with the discal macular band as in the male but white, and the four anterior spots larger, all the spots outwardly sharply defined by a fine line of the ground-colour; beyond the macular band is a broad whitish fascia from near the costa to the inner margin, bearing an increasing series of six black spots, the spot in the submedian interspace double. *Hindwing* has the spots of the discal band smaller than in the male, diamond-shaped, well-separated, outwardly sharply

* Vide Proceedings A. S. B., 1892, p. 144.



defined as in the forewing, pure white; the broad whitish discal fascia beyond bearing a series of prominent black lunules. **UNDERSIDE**, both wings as in the male.

The male of *E. eion* may be known from the same sex of *E. teuta*, Doubleday and Hewitson, which appears to be confined to Assam and Northern Burma, by the subapical spot of the forewing on the upper-side being smaller, and by the presence of the submarginal series of seven decreasing white spots on the hindwing. The female is at once distinguished by the broad whitish fascia across both wings on the upper-side beyond the discal macular band, also by the spots of the latter being smaller and well separated. *E. teuta* has been recorded by Mr. Moore from Java and by Mr. Druce from Borneo. It is doubtful if it occurs in either island, the Javan species being *E. eion*, and the Bornean *E. bellata*, Druce.

Described from two males and two females in my collection, received from Mr. H. Fruhstorfer, and one male in the collection of Herr George Semper, taken in February.

11. *EUTHALIA (Dophla) ESON*, n. sp., Plate I, Figs. 3, ♂; 5, ♀.

Euthalia cenespolis, Staudinger (nec Hewitson), Iris, vol. ii, p. 73 (1889).

HABITAT: Palawan, Philippine Isles.

EXPANSE: ♂, 3.1; ♀, 3.7 inches.

DESCRIPTION: **MALE**. **UPPERSIDE**, both wings pale clear brown, all the veins fuscous and prominent. *Forewing* with a small dark round spot in the middle of the discoidal cell touching the subcostal nervure; two fine black lines on either side of the disco-cellular nervules; a discal series of eight semi-transparent pale yellow spots, each spot outwardly bounded by a fuscous line, which line is inwardly lengthened out into a point, the three anterior spots lengthened, the fourth and fifth in the median interspaces pyriform, the apex of each spot directed towards the base of the wing, two small spots in the submedian interspace, a minute one in the sutural area; beyond this series of spots is a pale fascia, prominent at the inner margin, becoming lost anteriorly at a small pale yellow spot in the subcostal interspace; this pale band is outwardly defined by a highly lunulated fuscous line, anteriorly becoming obsolete. *Hindwing* bearing a discal series of eight spots, the three anterior ones white, the others pale yellow, these five latter are each outwardly defined by a fuscous line, the uppermost spot on the costa narrow, elongated, the second spot the largest, rounded, the third a little smaller, oval, the next four small, equal-sized, the eighth posterior spot the smallest; a submarginal series of seven sagittate fuscous markings, the apex of each directed inwardly, and each bearing outwardly a

pale spot placed against it between the points of the forks. **UNDERSIDE**, *both wings* pale ochreous-brown washed with pale violet, the discal macular band of the upperside almost obliterated. *Forewing* with the markings in the discoidal cell as on the upperside, but much more prominent; an increasing submarginal series of black spots. *Hindwing* with a pair of fuscous lines defining the disco-cellular nervules; a submarginal series of eight linear black spots between the veins, the two posterior ones in the submedian interspace geminated. **FEMALE**, much paler than the male throughout, but very similarly marked. *Forewing* with all the spots of the discal series very much larger and pure white, the two uppermost spots greatly lengthened. *Hindwing* with all the spots of the discal series white, of nearly the same size as in the male. **UNDERSIDE**, *both wings* paler even than in the male, of a more ochreous shade, the markings similar.

This is a very distinct species and quite easily separable from all those that I have placed before it in the key. The ground-colour of the male on the upperside is quite feminine, being much paler than in any other species of this sub-group of *Euthalia*. The discal series of spots on the hindwing will separate it from all the other species except *E. externa*, de Nicéville, next described, owing to each spot standing alone, and the five posterior ones being outwardly defined by a black ring; from *E. externa* it may be known by its generally paler colour, and the discal series of spots on the forewing being smaller and more regular. The female is quite unique, being the only species in the sub-group with the discal series of spots of the forewing regularly increasing in width towards the costa, the uppermost spot being extremely wide. The female of *E. eson* greatly reminds one of the same sex of *E. (Tanaëcia) pulasara*, Moore.

Described from a single pair of specimens in Herr Georg Semper's collection, to whom I am greatly indebted for the loan of his entire series of this sub-group of *Euthalia*. These specimens of *E. eson* are from those collected by Dr. Platen, who obtained ten males and eight females.

12. *EUTHALIA (Dophla) EXTERNA*, n. sp., Plate II, Fig. 1, ♂; 2, ♀.

HABITAT: Nias Island.

EXPANSE: ♂, 2·8; ♀, 3·3 inches.

DESCRIPTION: **MALE**. **UPPERSIDE**, *both wings* shining fuscous, outwardly paler. *Forewing* with the usual black spot in the middle and pair of lines closing the discoidal cell; a discal irregular series of seven pale primrose-coloured spots, outwardly (owing to the ground-colour at this point being paler than the rest of the wing) defined rather broadly with fuscous, the anterior spot obsolete, a thin blurred line only, the

second and third spots also linear but of a good breadth, the fourth and fifth spots in the median interspaces somewhat irregular ovals, the fifth the largest in the series, the sixth spot constricted in the middle, almost bisected, the seventh spot small and oval; a well marked submarginal black fascia formed of regular lunules, anteriorly becoming smaller and lost altogether in the subcostal interspace, which bears between the discal series of spots and the submarginal lunular fascia a small round yellow spot. *Hindwing* with a prominent discal series of eight spots, the three anterior ones white, the five posterior ones pale primrose-coloured, these latter outwardly defined by a broad black line, the uppermost spot on the costa linear, the second the largest, the third next in size, the sixth the smallest, the fourth, fifth and seventh equal-sized; a prominent highly-lunulated submarginal black fascia placed on a pale ground, the two anteriormost portions of this band quadrate, bearing each a whitish spot on either side. *UNDERSIDE*, both wings ochreous, more or less washed with purplish; a submarginal series of small round black spots between the veins. *Forewing* with the ring-spot in the middle and double line closing the cell very prominent; the discal band white, obscure, each spot forming it outwardly defined by a thin dark line. *Hindwing* with a prominent small black ring-spot in the middle of the cell (this spot is absent in *E. eson*, de Nicéville, and *E. gupta*, de Nicéville, but is present in all the other species), two prominent black lines at the end of the cell; the spots forming the discal band much larger than on the upperside, all touching, and outwardly defined with a thin dark line. *FEMALE*. *UPPERSIDE*, both wings somewhat paler than in the male. *Forewing* similarly marked, but the spots of the discal band larger and pure white, as is also the subcostal spot; a prominent violet-white fascia between the discal and submarginal bands, extending from the inner margin to the lower discoidal nervule. *Hindwing* with the discal macular band of the male reduced to five spots only, all the spots very much smaller also, no spots posterior to the third median nervule. *UNDERSIDE*, both wings richer coloured than in the male, strongly tinted with ferruginous; the submarginal black spots all larger and more diffused. *Forewing* with the discal white band anteriorly much expanded. *Hindwing* with a well-formed prominent discal macular white band, extending from the costa to the abdominal margin, the spots posterior to the first median nervule run into a single spot undivided by the crossing veins.

The male of *E. externa* is nearest to the same sex of *E. eson*, de Nicéville; I have pointed out above how they differ. The female of *E. externa* is nearest to *E. goodrichi*, Distant, from Perak, from which it may be known by the spots of the discal series of the forewing on the



upperside being three times as large, greatly reducing thereby the pale area between these spots and the submarginal band; on the hindwing above there are two spots less than in *E. goodrichi*; the submarginal lunulated black band is also much broader than in that species.

Described from a single pair of specimens in the collection of Herr Georg Semper.

13. *EUTHALIA (Dophla) EURUS*, n. sp., Plate II, Figs. 3, ♂; 4, ♀.

HABITAT: N.-E. Sumatra.

EXPANSE: ♂, 2.7; ♀, 3.3 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* shining fuscous, paler externally. *Forewing* with a discal macular very pale green band consisting of seven spots, the uppermost spot of all out of line, placed nearer the base of the wing than those which follow it; the three uppermost spots small and linear, the fourth spot larger, rounded, the fifth spot larger than the fourth, also rounded, the sixth spot the largest of all, outwardly strongly cleft, the seventh spot on the inner margin small and quadrate; the usual subapical pale green dot in the subcostal interspace; an indistinct increasing submarginal macular black fascia. *Hindwing* with a conjoined macular discal very pale green band consisting of eight spots, the three uppermost spots, however, are white, the inner edge of the fascia straight and even, the outer edge saw-like, as each spot is produced into a point; a submarginal lunular black fascia, each lunule of which the fascia is composed bearing outwardly a whitish spot, the three uppermost of these increasingly prominent. UNDERSIDE, *both wings* greenish-ochreous, washed with violet; the discal macular band much as on the upperside; the submarginal fascia reduced to small linear black spots between the veins. *Forewing* with a black ring-spot in the middle, and a double lunular spot closing the discoidal cell, both filled in with crimson. *Hindwing* with a black dot in the middle and a double black line closing the cell, the latter faintly tinged with crimson in the middle. FEMALE. UPPERSIDE, *both wings* shining brownish-ochreous, the disc powdered with pale violet-white which merges again into the dark outer margin. *Forewing* with the markings on the underside in the discoidal cell shewing through; the discal series of spots increased to eight, white, each spot outwardly defined by a brown line; the three anterior spots linear, large, the fourth and fifth of equal size, the sixth and seventh in the submedian interspace well separated, the eighth on the inner margin oval; the subapical spot much larger than in the male; a submarginal series of six black spots placed between the veins. *Hindwing* with the discal macular band as in the forewing, but consisting of seven spots only, the series ending

posteriorly in the first median interspace; the uppermost spot on the costa linear, the second spot the largest of all, the rest decreasingly smaller; a prominent highly zig-zag submarginal black line. **UNDERSIDE**, both wings paler than on the upperside, the markings very similar, those in the discoidal cell as in the male.

The male of this species, as in the rest of the group, except *E. recta*, de Nicéville, is barely distinct from its allies, it is, however, nearest to *E. eion*, de Nicéville, from Java, described above. The female is nearest to *E. bellata*, Druce, from Borneo, of which latter I possess a specimen for comparison, from which it differs in the broad pale violet-powdered discal area, especially marked in the hindwing. Mr. Hewitson's figure of the female of *E. bellata*, in 'Exotic Butterflies,' vol. v, *Adolias* pl. iv, fig. 14 (1875), where it appears as *E. cenepolis*, does not quite agree with my specimen, his figure shewing a very large powdery-violet area in the forewing extending within the discal band, this area being very faint in my example, and confined to the region beyond the discal band. My female of *E. eurus* differs, however, markedly from Hewitson's figure of *E. cenepolis*, and my example also from Borneo, in having a broad discal powdery-violet area to the hindwing on the upperside.

Described from two males and a female example in Dr. Martin's, and two males in my own collection, all from N.-E. Sumatra.

The four last butterflies described above belong to a small but well-marked group of the large genus *Euthalia*, and appear to come into the subgenus *Dophla*, Moore, of which *E. evelina*, Stoll, is the type. All the species of *Dophla*, as I understand the subgenus, are remarkable in having on the underside of both wings a black ring-spot in the discoidal cell, and a pair of black lines on either side of the disco-cellular nervules centred with crimson. The ring-spot is absent however in two species, *E. eson*, de Nicéville, and *E. gupta*, de Nicéville, in the hindwing only. In the *E. evelina* group there are sometimes other crimson markings in the hindwing anterior to the discoidal cell. In all the species of *Dophla* the discoidal cell is closed in both wings by a very slender almost aborted veinlet, and the subcostal nervules of the forewing never anastomose. The outline of the wings is distinctive, the outer margin being highly emarginate in the forewing, giving that wing a more or less falcate appearance. The cilia are very short, and the butterflies give one the idea of having been neatly trimmed round the edges with a pair of scissors. To facilitate reference to the subgroup to which the four species above described belong, I give a key to the known species. The males of several of them are so closely allied that



they are almost indistinguishable, the one from the other; but the females are in all cases abundantly distinct, so I have based the key mainly on that sex.

Key to certain species of the subgenus Dophla allied to E. teuta, Doubleday and Hewitson.

A. Male and female, upperside, forewing with the discal macular band straight.

(1.) *E. (Dophla) RECTA*, Khasia Hills; Burma; Goping, Perak, Malay Peninsula (coll. Semper).

B. Male and female, upperside, forewing with the discal macular band curved, the anterior spot out of line, placed nearer the base of the wing than the rest.

a. Female, upperside, with the discal macular band extending from the costa of the forewing to the abdominal margin of the hindwing.

a¹. Female, upperside, both wings with a prominent white fascia exterior to the discal macular band.

(2.) *E. (Dophla) EION*, Java.

b¹. Female, upperside, both wings with no prominent white fascia exterior to the discal macular band.

a². Female, upperside, forewing, the two anterior spots of the discal macular band small, smaller than the third spot.

a³. Female, upperside, both wings with the submarginal black fascia highly lunulated.

(3.) *E. (Dophla) TEUTA*, Assam; Arracan Hills; [Java, Moore; Borneo, Druce].

b³. Female, upperside, both wings with the submarginal black fascia composed of quadrate spots, forming a broad fascia with straight edges.

(4.) *E. (Dophla) PIRATICA*, Luzon, Mindoro, Camiguin de Mindanao, Nord-Mindanao, Philippine Isles.

b². Female, upperside, forewing, the two anterior spots of the discal macular band very large, larger than the third spot.

(5.) *E. (Dophla) TEUTOIDES*, South Andaman Isles.

b. Female, upperside, with the discal macular band extending from the costa of the forewing to the submedian nervure of the hindwing.

(6.) *E. (Dophla) ESON*, Palawan, Philippine Isles.

c. Female, upperside, with the discal macular band extending from the costa of the forewing to the third median nervule of the hindwing.

a¹. Female, upperside, forewing with a prominent violet-white fascia between the discal and submarginal bands, extending from the inner margin to the lower discoidal nervule; the discal spots very large.

(7.) *E. (Dophla) EXTERNA*, Nias Island.

b¹. Female, upperside, forewing with no prominent violet-white fascia between the discal and submarginal bands; the discal spots small.

(8.) *E. (Dophla) GOODRICHII*, Perak.*

* Mr. Distant first described this species from Perak in the Malay Peninsula as *Euthalia goodrichi*, but subsequently sank that name in his '*Rhopalocera Malayana*,' p. 436, n. 17, as a synonym of *E. bellata*, Druce, equals *Adolias cenesopolis*,



d. Female, upperside, with the discal macular band extending from the costa of the forewing to the first median nervule of the hindwing.

a¹. Hindwing with a prominent powdery-violet fascia between the discal macular band and the lunulated submarginal line.

(9.) E. (*Dophla*) EURUS, N.-E. Sumatra.

b¹. Hindwing with no prominent powdery-violet fascia between the discal macular band and the lunulated submarginal line.

(10.) E. (*Dophla*) BELLATA, Borneo.

c. Female, upperside, hindwing with no discal macular band; the spots of the forewing small.

(11.) E. (*Dophla*) GUPTA, Burma, Plate II, Fig. 5, ♀.

14. CYRESTIS THERESE, n. sp., Plate V, Fig. 8, ♂.

HABITAT: Selesseh, N.-E. Sumatra; Borneo.

EXPANSE: ♂, 1.9 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* rich fulvous. *Forewing* with the following black markings:—A short straight line at the extreme base of the wing; a second line oblique but straight, from the costa to the submedian nervule; a third line straight from the subcostal nervule to the inner margin; a fourth line much bowed outwardly, confined to the discoidal cell; a fifth line short, straight, also confined to the cell immediately within the disco-cellular nervules, and touching the fourth; a sixth line also straight, a little beyond those veins, commencing on the subcostal nervule, and ending close to the base of the second median nervule; a seventh line angled, commencing at the costa and ending on the inner margin, the angulation being at the point where it crosses the second median nervule, the angle directed outwards; an eighth line broad, almost straight, slightly outwardly curved only, reaching from the costa to the inner margin; a ninth line narrower than the eighth, slightly sinuous, posteriorly zig-zaged, of a deep black colour, from the costa to the inner margin; a tenth line straight, extending from the costa to the first median nervule, with two prominent small round black spots in continuation in the submedian interspace; an eleventh line very narrow and straight, from the costa to the first median nervule; a twelfth line broad, paler, of similar position to the eleventh; a thirteenth line narrow, deep black, close to the outer

Hewitson, both the latter described from Borneo. As in the female of *E. goodrichi* the discal band of the hindwing on the upperside ends at the third median nervule, while in *E. bellata* it ends at the first, and in the latter all the spots of the hindwing are much larger, besides other minor differences, I think the two species may be kept distinct, and the name *E. goodrichi* revived. I possess one female of the Bornean species, and have access to three pairs of the Perak species in Semper's, Adams', and my own collection.

margin; the outer margin itself narrowly fuscous. *Hindwing* with an indistinct sub-basal black line; a second line from the costa losing itself in the abdominal region; the third and fourth lines exceedingly fine, on either side of the disco-cellular nervules; the fifth line from the costa ending in the abdominal region; the sixth line answering to the eighth line in the forewing, and like it fuscous, not deep black, extends from the costa, and runs into the ninth line in the first median interspace; the seventh line narrow, jet-black, from the costa to the first median nervule; the eighth line, composed of six detached portions, commences posterior to the first subcostal nervule and ends at the first median nervule; the ninth line extremely narrow and deep black, from the costa to the first median nervule; the tenth line broad, rather diffused, fuscous, sub-marginal; the eleventh line fine, deep black, following the margin; the outer margin itself narrowly fuscous: the usual large rounded clump of confused bluish and black markings at the anal angle anterior to the large anal lobe; a small round black spot encircled with whitish anterior to this clump, placed just within the second angle made by the abdominal margin; the anal lobe rich fulvous centred with a black spot. *UNDERSIDE*, both wings much paler than on the upperside; the markings very similar but usually paler. *Forewing* with a quadrate whitish patch on the inner margin between the eighth and ninth lines. *Hindwing*, anal lobe with the central black spot much larger than on the upperside.

C. theresæ is an abundantly distinct species, and comes into the group containing *C. thyonneus*, Cramer, which I possess from Celebes; *C. tabula*, de Nicéville, from Great Nicobar Island; and *C. lutea*, Zinken-Sommer, which is common in Java. In size it agrees with *C. lutea*. In the coloration of the ground of the upperside it is nearest to *C. tabula*, but is rather lighter, it is much darker than *C. lutea*, lighter than *C. thyonneus*. The tail to the hindwing is less than half as long as in either of the above-mentioned species. In markings it agrees best with *C. thyonneus*, but differs in many details, as, for instance, the seventh and ninth lines on the hindwing in that species are dark metallic steel-blue, in *C. theresæ* they are black without any metallic lustre.

Described from an unique specimen in Dr. L. Martin's collection, taken in the virgin forest of Selesseb, on the 21st May, 1893; also from another example from Borneo given to me by Dr. Martin. At his suggestion I name the species after H. R. H. the Princess Therese of Bavaria, daughter of the Prince Regent, who is a student and lover of Natural History.

Borneo, the type being from Sarawak, and in my collection are three males and a female from S.-E. Borneo. Mr. Distant records *L. telesia* from Sumatra, but this species is probably the one meant.

18. *LAXITA LYNCESTIS*, n. sp., Plate II, Fig. 8, ♂.

HABITAT: Malay Peninsula.

EXPANSE: ♂, 1.7 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings and cilia* fuscous. *Forewing* with a band of crimson on the outer margin, wide on the costa, fining away to nothing at the anal angle; a broad oblique discal bluish-white band, commencing anteriorly just anterior to the lower discoidal nervule, ending just before the anal angle on the submedian nervule, notched inwardly at the origin of the second median nervule, anteriorly inwardly bounded by the disco-cellular nervules. *Hindwing* with the usual shining pale fuscous costal area bearing the "male-mark" of the genus. UNDERSIDE, *forewing* differs from *L. orphna*, Boisduval, in having numerous metallic blue markings on the disc, in the present species there are two such spots placed outwardly against the two inner black spots in the median interspaces, and three such spots placed outwardly against the three black spots beyond the outer end of the cell, with a series of five others beyond extending across the disc; in *L. orphna* all these blue spots are lacking. *Hindwing* as in *L. orphna*.*

This species is not included in Mr. Distant's "*Rhopalocera Malayana*." On the upperside it differs from two male specimens of *L. orphna* in my collection from S.-E. Borneo in its smaller size, brighter crimson outer border to the forewing on the upperside, and narrower discal bluish-white band, which latter in *L. orphna* is not inwardly notched below the cell.

Described from a single specimen in my collection from Perak.

There is one species of *Laxita* which I am still unable to identify. This is the butterfly figured by Hewitson in "*The Genera of Diurnal Lipidoptera*," vol. ii, p. 422, n. 7, pl. lxix, figs. 7, *male*; 6, *female* (1851), as "*Emesis orphna*, Boisduval," but re-named "*Taxila*" *tanita*, by Hewitson, in his "*Exotic Butterflies*," vol. ii, *Taxila* pl. i, text (1861). Mr. Distant in his "*Rhopalocera Malayana*," p. 192, n. 5, pl. xviii, fig. 14, *female* (1883), describes and figures an "*Abisara*" *tanita*. This female specimen does not at all agree with Hewitson's figure of the

* The differences pointed out above on the underside of the forewing will be at once observed by comparing the original figure of *L. orphna* in Boisduval's "*Species Général*," vol. i, pl. xxi, fig. 4, *female* (1836), with my figure of *L. lyncestis*.

female. It appears to me probable that Hewitson's male figure and Distant's female figure refer to one species, which might stand as *L. tanita*, the locality for which, as given in "The Genera," p. 422, n. 7, is "Borneo; India," but requires to be verified. I have seen no specimens agreeing with these two figures, Hewitson's n. 7, *male*, and Distant's *female*; the species if distinct is very near to *L. damajanti*, Felder. The species represented in Hewitson's fig. n. 6, *female*, should, it appears to me, if re-discovered, be named. It is apparently nearest to *L. telesia*, Hewitson, but has the chrome-yellow area at the apex of the forewing on the upperside much larger than in that species. Mr. Distant has further complicated matters by describing Hewitson's female figure n. 6 as a male. The bowed-out inner margin of the forewing in the males of the genus *Laxita* will at once distinguish them from the females, which have the inner margin straight. The species which Dr. Staudinger figures as "*Taxila*" *tanita*, Hewitson, in his "Exotische Schmetterlinge," p. 239, pl. lxxxvii, *male* (1887), appears not to differ from what I identify as *L. damajanti*.

Family LYCÆNIDÆ.

19. GERYDUS GIGANTES, n. sp., Plate V, Figs. 1, ♂; 13, ♀.

HABITAT: Penang; Battak Mountains, N.-E. Sumatra.

EXPANSE: ♂, 2.0; ♀, 1.8 to 2.1 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* pure chalky-white. *Forewing* with the basal third of the costa reaching to the subcostal nervure dusky; the costa beyond this, the apex and the outer margin broadly black, the inner edge of this large black area very irregular, it just enters the anterior outer angle of the discoidal cell, is pointed inwardly on the second median nervule, closely approaches the outer margin (exactly as in typical *Terias hecabe*, Linnæus) in the first median and submedian interspaces, the black area is wider again from the submedian fold to the inner margin; a small portion of the base of the third median nervule prominently swollen, this being a characteristic secondary sexual character in this genus. *Hindwing* with the costa outwardly broadly black. *Cilia* of both wings fuscous. UNDERSIDE, *forewing* black, the disc crossed by a pure white oblique macular band formed of four portions; two small and obscure ring-spots in the cell, one on the costa about two-thirds from the base of the wing; the apex and outer margin decreasingly pale ferruginous, the inner edge of this area bearing anteriorly a series of four whitish ring-spots; a sub-marginal series of black dots between the veins; a rather large oblong dark spot placed obliquely at the anal angle. *Hindwing* pale ferrugi-

nous; bearing regularly over the surface darker red spots arranged much as in typical species of the genus *Arhopala*, Boisduval, these spots are disposed thus:—A small round one at the extreme base of the wing; followed by a series of three single spots; then another series of three, but these spots are double; then four conjoined spots at the extremity of the cell; then a discal curved band extending across the wing from the costa to the abdominal margin, broken only by the first subcostal nervule; some obscure spots on the outer margin. FEMALE. UPPERSIDE, *both wings* marked almost exactly as in the male. UNDERSIDE, *forewing* differs from the male in having the discal macular band more extensive and run together into a single undivided band, anteriorly bounded by the subcostal nervure, posteriorly by the inner margin, along which it extends to the base of the wing. *Hindwing* with the macular markings less conspicuous than in the male; the inner edge of the discal series of spots bears on the posterior half of its length a series of black spots often found in the species of this genus.

G. gigantes is not only the largest known, but is the most conspicuously-marked species in the genus, and has no near ally. Were the ground-colour of the upperside yellow, instead of pure white, it would almost exactly resemble *Terias hecabe*.

I have described the species from a male and two females in Dr. Martin's and my collection, taken in the Battak Mountains of N.-E. Sumatra, in August and November, and another pair in Mr. A. R. Adams' collection taken at Penang.

20. *GERYDUS GÆTULUS*, n. sp., Plate V, Fig. 12, ♀.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♀, 1.3 and 1.5 inches.

DESCRIPTION: FEMALE. UPPERSIDE, *forewing* pure white; the costa basally, and the base of the wing, dusky; the apex very broadly black, as is also the outer margin at the anal angle, but much more narrowly so. *Hindwing* with the disc only white, the rest of the wing dusky; the disco-cellular nervules marked by a prominent blackish line. UNDERSIDE, *forewing* with the disc white, the rest of the wing pale slate-colour; three increasing dark spots outlined outwardly with white in the discoidal cell, a dark spot posterior to the middle one of these in the submedian interspace; three ring-spots on the costa; a short subapical macular band ending posteriorly in a separated round spot in the second median interspace; an oblique prominent spot at the anal angle; a submarginal series of black dots between the veins. *Hindwing*, pale slate-colour, with the macular markings as usual in the genus.

Nearest apparently to *G. zinckenii*, Felder, from Java, of which



I have a good series, but it may at once be known from that species on the upperside by the hindwing being white on the disc with a prominent dark disco-cellular line, *G. zinckenii* being dusky throughout; on the underside the ground-colour is a pale slate-colour, in *G. zinckenii* it is pale ferruginous.

Described from two specimens, one in Dr. Martin's and one in my collection, taken in the Battak Mountains in October, 1892.

21. *GERYDUS GALLUS*, n. sp., Plate V, Fig. 11, ♀.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♀, 1.5 inches.

DESCRIPTION: FEMALE. UPPERSIDE, *both wings* fuscous. *Forewing* with the apical area darker than the basal; crossed by an oblique discal white band with highly irregular edges, not quite reaching the costa or the outer margin above the anal angle, ending posteriorly on the submedian fold. *Cilia* fuscous. *Hindwing* immaculate. *Cilia* anteriorly white, becoming fuscous towards the anal angle. UNDERSIDE, *both wings* highly variegated, being coloured black, white, pale ochreous, and ferruginous. *Forewing* with the ground-colour black; the discal white band as above but broader, its edges even, reaching the outer margin at the anal angle; a pale ochreous patch at the apex, below which the ground-colour is ferruginous; three white ring-spots on the costa; two similar ones in the discoidal cell; a prominent black spot at the anal angle; a submarginal macular black line. *Hindwing* with the anterior half pale ochreous, the posterior fuscous mottled with ochreous; the macular markings as usual, though somewhat indistinct.

This may be a highly variegated form of *G. symethus*, Cramer, a common species in N.-E. Sumatra, but it differs greatly from any specimen of that species in my large suite of examples from the Malay Peninsula, Sumatra, Borneo, and Java, from all of which *G. gallus* differs in the white band on the upperside of the forewing being half as wide, the hindwing concolorous throughout, and by the highly variegated markings of the underside.

Described from a single example in Dr. L. Martin's collection.

As the genus *Gerydus*, Boisduval, has vastly increased in numbers in recent years, it may perhaps be useful to add a list of the described species, as far as I know them. Many species described in this genus do not belong to it at all, and have been excluded. The flattened legs of all the species is an unique character by which they may be instantly known. The list is headed by the largest, most beautiful, and most aberrant species.

(1) *GERYDUS GIGANTES*, de Nicéville, Penang, N.-E. Sumatra (*de Nicéville*).

(2) *GERYDUS SYMETHUS*, Cramer, East Indies (*Cramer*), Moulmein, Penang, Malacca, Perak, Johore, Sumatra, Nias Island, Java, Borneo, Pulo Laut, Palawan, Luzon, Mindanao, Jolo Islands, S.-W. Celebes, Amboina, Sumba, Sambawa, Ceram, Goram, Flores, New Guinea.

Mr. Doherty considers that the *G. pandu*, Horsfield, described from Java, which is generally given as a synonym of this species, may be distinct. I am unable, however, to find any character by which the two species can be separated.

(3) *GERYDUS PETRONIUS*, Distant, N. Borneo (*Distant*).

(4) *GERYDUS TEOS*, Doherty, Sumba, Sambawa (*Doherty*).

(5) *GERYDUS GALLUS*, de Nicéville, N.-E. Sumatra (*de Nicéville*).

(6) *GERYDUS BIGGSII*, Distant, Malacca (*Distant*), Burma, Perak, Sumatra, Nias Island, Pulo Laut.

(7) *GERYDUS GOPARA*, de Nicéville, Perak (*de Nicéville*), Johore, Singapore, North Borneo.

This species is placed by Mr. H. J. Elwes and Mr. W. Doherty as a synonym of *G. biggsii*, which is probably correct.

(8) *GERYDUS DRUCEI*, Semper, Bohol in the Philippine Islands (*Semper*).

(9) *GERYDUS ZINCKENII*, Felder, Java (*Felder*).

(10) *GERYDUS GÆTULUS*, de Nicéville, N.-E. Sumatra (*de Nicéville*).

(11) *GERYDUS CHINENSIS*, Felder, Hongkong (*Felder*).

(12) *GERYDUS CHINENSIS*, var. *CERAMENSIS*, Ribbe, Celebes, Amboina, Saigun, Baru, Borneo (*Ribbe*).

(13) *GERYDUS IRRORATUS*, Druce, Siam (*Druce*), Luzon, Palawan.

(14) *GERYDUS IRRORATUS*, var. *ASSAMENSIS*, Doherty, Naga Hills (*Doherty*), Perak, Pulo Laut.

(15) *GERYDUS PHILIPPUS*, Standinger, Palawan (*Staudinger*).

This species is placed by Herr Georg Semper as a synonym of *G. irroratus*, Druce.

(16) *GERYDUS BOISDUVALI*, Moore, Java (*Moore*), Sikkim, Assam, Chittagong Hill Tracts, Burma, Shan States, Singapore, Saigon, Amboina, Batjan, Baru, Ceram, Ké Islands.

(17) *GERYDUS BOISDUVALI*, var. *ACRAGAS*, Doherty, Sumba, Sambawa (*Doherty*).

(18) *GERYDUS LEARCHUS*, Felder, Luzon, China (*Felder*).

(19) *GERYDUS STYGIANUS*, Butler, Ternate (*Butler*).

(20) *GERYDUS MELANION*, Felder, Luzon (*Felder*), Cebú, Samar, Bohol, Camotes, Panaon, Camiguin de Mindanao, Mindanao.

(21) *GERYDUS CROTON*, Doherty, Burma (*Doherty*), East Pegu.



- (22) GERYDUS MAXIMUS, Holland, Celebes (*Holland*).
- (23) GERYDUS ANCON, Doherty, Tavoy (*Doherty*).
- (24) GERYDUS HERACLEION, Doherty, Perak (*Doherty*).
- (25) ? GERYDUS PLAUTUS, Fabricius, the Indies (*Fabricius*).
- (26) ? GERYDUS LEOS, Guérin, Bouru (*Guérin*).

22. PARAGERYDUS PORTUNUS, n. sp., Plate V, Fig. 14, ♂.

HABITAT: Java.

EXPANSE: ♂, 1.5 and 1.6 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* dull hair-brown. *Forewing* with the usual ochreous lines on the costa and pale area on either side of the swollen third median nervule. UNDERSIDE, *both wings* pale ochreous, profusely and evenly sprinkled throughout with minute ferruginous spots. *Forewing* with the inner margin somewhat paler and free of markings, though bearing two or three striae larger than the others towards the base of the wing.

This species appears to be nearest to *P. taras*, Doherty, which has the apex of the forewing on the underside "rufous-brown," while *P. portunus* has the whole of the underside of that colour, the ground-colour of *P. taras* is white, of *P. portunus* pale ochreous. Of *P. taras* I have captured both sexes in the Meplé Valley, middle Tenasserim, in October.

Mr. Doherty, who takes particular interest in this group of the *Lycænidæ*, has recorded his feelings of doubt as to whether the genus *Paragerydus* can be maintained as distinct from the genus *Allotinus*.* As far as the specimens of both genera contained in my collection are concerned, I am of opinion that the two genera may well be kept distinct. The length, and consequently the point of origin, of the third subcostal nervule of the forewing, certainly varies greatly, but in all my examples of *Paragerydus* the upper discoidal nervule originates from the subcostal nervule well beyond the apex of the discoidal cell; while in all my examples of *Allotinus* it originates at the apex, which feature constitutes a well-marked difference, and can be instantly detected by the application of a little benzine to the wing to make it transparent.

P. portunus is described from two specimens sent me by Mr. H. Fruhstorfer.

23. PARAGERYDUS PYXUS, n. sp., Plate V, Fig. 2, ♂.

HABITAT: Borneo.

EXPANSE: ♂, 1.4 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* rufous-brown. *Forewing*

* Journ. A. S. B., vol. lviii, pt. 2, p. 437 (1889).

with the lines on the costa and "male-mark" as usual. **UNDERSIDE**, both wings pale rufous, profusely and evenly sprinkled with dots and spots of a deeper rufous colour; a marginal series of very small black spots, one in each interspace.

Closely allied to *P. portunus*, mihi, from Java, but differs on the upperside in being rufous-brown, instead of dull hair-brown, and on the underside in having the ground-colour pale rufous instead of pale ochreous, and in the presence of the marginal black dots.

Described from a single example received from the late Mr. W. Davison.

24. *LOGANIA LUCA*, n. sp., Plate II, Fig. 13, ♀.

HABITAT: Perak, Malay Peninsula; N.-E. Sumatra.

EXPANSE: ♀, 1.0 inch.

DESCRIPTION: FEMALE. **UPPERSIDE**, forewing with the basal half milky-white, the outer half fuscous, the costa and base dusky, the extreme costa dotted with white on the basal half. Hindwing fuscous, the disc obscurely purplish-white. **UNDERSIDE**, both wings with the ground-colour probably white, but the surface is so thickly irrorated with brownish-ochreous that the ground-colour appears only as minute white dots profusely and evenly scattered over the surface mixed with a few black scales. Forewing with an obscure darker spot towards the end of the discoidal cell, and a similar discal band. Hindwing with some very obscure dark spots towards the base, an oblong one at the end of the cell, and a curved discal band crossing the wing from the costa to the abdominal margin.

Probably nearest to *L. marmorata*, Moore, the two original specimens of which, in very poor condition (probably both females, one certainly is that sex, the body of the other is lost, but the shape of the wings is certainly feminine), are before me. *L. luca* differs from them in having the outer margin of both wings more even, not distinctly scalloped, and the ground-colour of the underside is far redder, with the irrorations much more dense; this latter, however, is a variable feature in *L. marmorata*, as shewn in Mr. Moore's and my figures of the species taken from different specimens. *L. luca* may be still nearer to *L. obscura*, Distant, but the short original description of the latter does not in several particulars fit my specimens; Semper's and Staudinger's figures of the species agree very well with my specimens on the upperside, but neither of them agree on the underside.

I took two fresh specimens of this species in the high forest at Namoo Oekor, in October, 1893. They were flying amongst and settling on the low bushes growing under the high trees. I also possess two other females from Perak.

As far as I am aware, the genus *Logania* contains the following species. I include in it the two species, *L. marmorata*, Moore, and *L. sriwa*, Distant, which constitute Mr. Doherty's genus *Malais*, as he himself doubted subsequently the validity of the genus.* I have arranged the species chronologically.

(1) ? *LOGANIA REGINA*, Druce, Borneo (*Druce*). This species may be an *Allotinus*. To judge from the figure, the type specimen must have been a male, as the body is very long. Mr. Druce does not say what sex he described.

(2) *LOGANIA MALAYICA*, Distant, Sungei Ujong, in the Malay Peninsula (*Distant*); S.-E. Borneo; Pulo Laut; Sibulan, S.-E. Mindanao, one of the Philippine Isles.

(3) ? *LOGANIA LAHOMIUS*, Khie!, Nias Island (*Khie!*). This species may also be an *Allotinus*. The specimen figured seems to be a male, as it has a very long body.

(4) *LOGANIA MARMORATA*, Moore, Elphinstone Island in the Mergui Archipelago (*Moore*); Monè in the Shan States; Perak; N.-E. Sumatra; Pulo Laut.

(5) *LOGANIA SRIWA*, Distant, Malacca (*Distant*); Perak; Pulo Laut.

(6) *LOGANIA OBSCURA*, Distant, Northern Borneo (*Distant*); Palawan, Cebú, and East Mindanao, in the Philippine Isles.

(7) *LOGANIA DISTANTI*, Semper, Cebú, S.-E. Mindanao, Philippine Isles (*Semper*).

(8) *LOGANIA DISTANTI*, Staudinger, Palawan (*Staudinger*). Herr Semper places this species as a synonym of *L. obscura*.

(9) *LOGANIA MASSALIA*, Doherty, Margherita, in Upper Assam (*Doherty*).

(10) *LOGANIA LUCA*, de Nicéville, N.-E. Sumatra (*de Nicéville*).

25. *SIMISKINA SOLYMA*, n. sp., Plate IV, Fig. 10, ♀.

HABITAT: Gapis, near Taiping, Perak, Malay Peninsula.

EXPANSE: ♀, 1.6 inches.

DESCRIPTION: FEMALE. UPPERSIDE, both wings fuscous. Forewing with a large oval discal white patch, which, in some lights, is entirely suffused with beautiful rich iridescent emerald-green, and in all lights is more or less bordered by this colour; the patch commences beyond the discoidal cell just anterior to the third median nervule, and reaches the inner margin, its posterior portion, however, is much diffused; just beyond the patch are two rounded emerald-green spots divided by the second median nervule. Hindwing with a rather large

* Journ. A. S. B., vol. lviii, pt. 2, pp. 415, 436 (1889); vol. lx, pt. 2, p. 29 (1891).

emerald-green spot in the second median interspace; three lunulated emerald-green lines beyond in the two median and submedian interspaces; a marginal emerald-green thread, broken where it is crossed by the veins, obsolete towards the apex of the wing; the costa of the wing broadly pale ochreous. **UNDERSIDE**, *both wings* with the basal third chocolate-colour, the outer two-thirds ochreous. *Forewing* with the base of the inner margin ochreous; a broad discal wedge-shaped chocolate-coloured band with its base on the costa, its apex on the submedian nervure; its outer edge closely followed by a narrow chocolate line; the outer margin broadly chocolate. *Hindwing* with a macular, short, but rather broad, chocolate line on the middle of the disc; followed by five large chocolate spots divided only by the veins, the middle one the largest, the one on either side of it smaller, the two outermost spots the smallest; these five spots are followed by a macular band extending right across the wing of somewhat diffused chocolate spots; these again are closely followed by a narrow chocolate line; the margin bears a series of lunular spots between the veins, of which the one in the second median interspace is the largest and black, the rest are black and chocolate; a fine anteciliary inner white and then an outer chocolate thread.

This species is quite unique, there is nothing remotely resembling it in the genera *Poritia* or *Simiskina*. The white patch on the upperside of the forewing at once reminds one of *Laxita telesia*, Hewitson, which has a similar patch in the male.

The type and only known specimen of this species is deposited in the collection of Mr. A. R. Adams of Penang, who caught it himself. I am much indebted to him for allowing me to describe so beautiful and interesting a species.

26. *PITHECOPS MARIE*, n. sp., Plate IV, Figs. 2, ♂; 9, ♀.

HABITAT: N.-E. Sumatra.

EXPANSE: ♂, .8 of an inch to 1.2 inches; ♀, 1.0 inch to 1.1 inches.

DESCRIPTION: **MALE**. **UPPERSIDE**, *both wings* rich deep shining blue, almost invisible in some lights. *Forewing* with the apex somewhat widely, the outer margin narrowly and decreasingly black. *Hindwing* with the costa broadly, the outer and abdominal margins less broadly, black. **UNDERSIDE**, *both wings* milky-white, a series of very fine black dots on the outer margin; an anteciliary black thread. *Forewing* with a very narrow blackish line defining the disco-cellular nervules; two small black dots on the middle of the costa, often absent; a submarginal decreasing ochreous fascia, which becomes dusky at the costa; within which at the anal angle are two fine ochreous lines one above the



other. *Hindwing* with a large round black spot at the apex; a submarginal ochreous line. FEMALE. UPPERSIDE, *both wings* dead plumbeous-black. *Forewing* with a short streak of blue scales in the lower discoidal interspace beyond the end of the discoidal cell. *Hindwing* unmarked. UNDERSIDE, *both wings* as in the male. *Cilia* throughout more prominently marked alternately black and white than in the male.

A comparison of the figure here given of the male (which, however, is a very poor one, drawn from a very small specimen, the first I received), with that of *Pithecopa fulgens*, Doherty,* from Margherita, in Upper Assam, of which I possess three males and two females, including the type specimens, will at once disclose the fact that on the upperside the male of *P. mariae* has the blue area of much greater extent (it is also of a deeper, more truly blue, shade), and on the underside, that it is far less heavily marked, the two costal dots of the forewing being often absent, and the apical spot of the hindwing often smaller.

The discovery of a second blue species of the genus is highly interesting. I have described it from several male examples received from Hofrath Dr. L. Martin; one taken by myself at Namoe Oekor in October, in the virgin forest, and three female examples in my own collection, and one in Dr. Martin's, after whose amiable wife I have great pleasure in naming it. Though this butterfly is so small, the male immediately attracts attention when flying by the wonderful refulgence of the coloration of the upperside of the wings.

27. CYANIRIS CRISSA, n. sp., Plate II, Fig. 12, ♂.

HABITAT: Nilgiri Hills and Ashambo Hills, South India.

EXPANSE: ♂, 1.35 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* shining violet-blue. *Forewing* with the costa narrowly, the apex widely, the outer margin broadly and evenly, black. *Hindwing* with the costa widely, the outer margin narrowly, black; five round black spots placed against the black border, one each in the discoidal and median, two in the submedian interspace. UNDERSIDE, *both wings* dead white, all the black markings unusually large and prominent; a marginal series of prominent spots, oval in the forewing, round in the hindwing; a submarginal prominent line, broader and lunulated in the forewing, narrower and more highly lunulated in the hindwing; a very fine anteciliary black thread. *Forewing* with a broad prominent comma-shaped mark closing the discoidal cell; a discal series of seven spots, the two anterior and two posterior spots in one straight line, the three middle spots out of line,

* Journ. A. S. B., vol. lvi, pt. 2, p. 127, pl. x, fig. 6, male (1889).

shifted outwardly. *Hindwing* with three large rounded spots across the base of the wing; a fine line at the end of the cell, a very irregular discal series of eight spots, of which the one on the costæ and the one on the abdominal margin are the most prominent. *Cilia* above dusky white, on the underside the cilia under a magnifying glass appear to be white at the base tipped with dusky.

C. crissa on the upperside agrees best with *C. placida*, de Nicéville, from Sikkim, Assam, Burma, the Malay Peninsula, and Java, but the outer black margin on the forewing is rather broader, and the submarginal black spots on the hindwing are better separated from the black margin. On the underside the two species are abundantly distinct, the markings in *C. crissa* being almost throughout deep black, while in *C. placida* they are dull fuscous, they are also far more prominent and larger in *C. crissa*. In the rains form of *C. puspa*, Horsfield, the markings on the underside are quite as prominent as in *C. crissa*, but they differ somewhat in character; in the hindwing especially the submarginal line is much nearer to the marginal spots in *C. puspa* than in *C. crissa*. *C. cyanescens*, de Nicéville, from the Nicobar Isles, is another allied species, but the markings on the underside are different, being smaller, less prominent, and more or less fuscous.

Described from a single example obtained at Kalar in the Nilgiri Hills by Lieut. E. Stokes Roberts, R. E., on the 17th August, 1892, another male taken in March, in the Ashambo Hills of Travancore, and received from Mr. Harold S. Ferguson.

28. EVERES MOOREI, Leech, Plate II, Fig. 11, ♂.

Lycæna moorei, Leech, Trans. Ent. Soc. Lond., 1889, p. 109, n. 45, pl. vii, fig. 3; idem, id., Butt. China, Japan, and Corea, p. 310, pl. xxxi, fig. 9, male (1893).

HABITAT: Kiukiang, Chang-yang, Central China (Leech); Khasia Hills.

The Rev. Walter A. Hamilton has sent me eight specimens of this species obtained by his native collectors in the Khasia Hills. It occurs also at Kiukiang and Chang-yang in Central China. The Indian specimens are a good deal smaller than the Chinese examples (23 as against 29 mms.), but do not differ in coloration and markings. The species is a true *Everes*, as I have ascertained by bleaching the wings of a specimen, but is a little abnormal, as the hindwing has no trace of a tail. This, however, in the *Lycanidæ*, cannot be accepted as a feature of generic or even specific value, as several instances occur in which the same species is both tailed and tailless. In the genus *Everes* not only is *E. moorei* tailless, but the type species, *E. argiades*, Pallas, is sometimes without tails, Mr. W. Doherty having obtained tailless

specimens in the Naga Hills, and Lieut. E. Y. Watson similar ones in the North Chin Hills of Upper Burma (Fort White, 7,000 ft., March and April; Tiddim, 5,500 ft., April), of which he has sent me a considerable series. *E. moorei* is not mentioned in Colonel Swinhoe's "List of the Lepidoptera of the Khasia Hills."*

29. *LAMPIDES LUCIDE*, n. sp., Plate V, Fig. 3, ♂.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♂, 1.6 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* milky-white more or less glossed with pale blue; all the fuscous bands, the dark costa, and base of the wing of the underside shining through as pale blue bands. *Forewing* with the apex broadly, and the outer border rather broadly and decreasingly black. *Hindwing* with a black anteciliary thread, within which is a series of small indistinct linear black lines between the veins; *cilia* white, tipped with black; *tail* black, tipped with white. UNDERSIDE, *both wings* chalky-white. *Forewing* with the basal two-thirds of the costa and the base of the wing sprinkled thickly with plumbeous scales; a broad straight fuscous band from the dusky costa to the submedian nervure covering the disco-cellular nervules; a similar but dislocated band beyond from the costa to the third median nervule; between these two bands is a quadrate spot in the second median interspace; a third short band from the costa to the lower discoidal nervule; a fourth band, submarginal, curved, from the costa to the submedian nervure; a fifth marginal narrow band; a rather broad anteciliary black thread. *Hindwing* with the base narrowly thickly sprinkled with plumbeous scales; crossed by seven fuscous bands which are more or less straight till they approach the abdominal area when they are all recurved to the abdominal margin, except the second band from the base of the wing, which ends on the first median nervule and is not recurved; a large oval black spot near the margin in the first median interspace, bearing at the corner nearest to the base of the tail a few brilliant metallic green scales, the spot broadly crowned with rich ferruginous; a small anal black spot bearing anteriorly a few metallic green scales, crowned by a ferruginous line; an anteciliary fine black thread. *Abdomen* plumbeous above, the segments marked with a white line, the abdomen below white.

This is a very remarkable species, and unlike any other. The coloration of the underside is reversed. In the other species of the genus the ground-colour is dark and the markings are white, in *L. lucide* the ground-colour is white and the markings are black. The broad black apex and outer margin of the forewing above, and the

* Trans. Ent. Soc. Lond., 1893, p. 297.

patch on the hindwing being placed in much the same position, though it is not quite so large and reaches quite up to the origin of the upper disco-cellular nervule, which it does not do in *Bindahara*, and it has a similar tuft of long hairs on the forewing; but it differs from the five Indian genera—*Hysudra*, *Rapala*, *Bindahara*, *Virachola*, and *Sinthus*, all of Moore—which possess the "scale" mark and tuft of hairs, in being entirely devoid of a tail to the hindwing. The genus is so entirely aberrant that it is very difficult to know where to place it, though its affinities are perhaps more with *Thecla*, Fabricius, than with any other.

31. *LISTERIA DUDGEONII*, n. sp., Plate IV, Fig. 3, ♂.

HABITAT: Bhutan.

EXPANSE: ♂, 1.25 inches.

DESCRIPTION: MALE. UPPERSIDE, *forewing* black; the discoidal cell, a small area at the base of the second and a larger area at the base of the first median interspace and thence broadly to the inner margin of the wing, but not nearly reaching the anal angle, bright blue. *Hindwing* with the costa broadly extending into the cell, the outer margin broadly but decreasingly to the anal angle, black; the abdominal margin broadly pale fuscous; the rest of the wing bright blue. UNDERSIDE, *forewing* pale fuscous inclining to pale ochreous broadly on the inner margin; a large reddish spot at the end of the cell, a discal macular reddish band from the costa to the first median nervule; a sub-marginal broad black-mixed-with-red band; the sexual tuft of hairs on the inner margin turned under and upwards pale ochreous. *Hindwing* with the base rather broadly black, the rest of the wing reddish, becoming darker towards the outer margin, where it is umber-coloured; beyond the black basal area is a broad area extending across the wing consisting of a confused mass of ill-shaped ochreous spots; the outer margin bears a double lunulated fuscous line, each pair of lunules enclosing a small space of the ground-colour. *Cilia* reddish throughout, broad and coarse, and very long on the hindwing, especially where they fringe the anal lobe.

The butterfly is so entirely different from all others known to me in shape, markings and sexual characters that I can compare it with none. It remotely reminds one of *Thecla frivaldszkyi*, Lederer, and allies, in the markings of the underside; but the coloration of the upper-side, the truncated apex of the forewing, and the "male-marks" are wholly dissimilar.

Described from a single example not in very perfect order, captured at 2,500 feet elevation above the sea by Mr. J. L. Lister, after whom I have much pleasure in naming the genus. As my friend Mr. G. C.

Dudgeon "discovered" the species in Mr. Lister's collection, I have named it specifically after him.

32. *CAMENA CREMERA*, n. sp., Plate V, Fig. 16, ♂.

HABITAT: Java.

EXPANSE: ♂, 1.7 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* cerulean-blue; *cilia* black, faintly tipped with grey on the hindwing. *Forewing* with the costa at the base very narrowly black, but the black area broadening out and reaching the subcostal nervure before the apex of the cell; the apex of the wing very widely black, narrowing away to nothing at the anal angle. *Hindwing* with the costal area broadly pale ochreous, polished; the outer margin narrowly black, but widening out somewhat at the apex of the wing; anal lobe small, inconspicuous, black, with a few turquoise-blue scales posteriorly, obscurely crowned with ochreous; the abdominal margin whitish. UNDERSIDE, *both wings* plumbeous; a common discal even-edged straight white band, widest at the costa of the forewing, ending on that wing at the first median nervure, in the hindwing commencing on the costa, ending on the submarginal dark line; a common submarginal narrow dark line, not quite reaching the costa of either wing, in the forewing slightly outwardly bowed, ending at the submedian nervure, in the hindwing much outwardly bowed, posteriorly zig-zag and recurved to the abdominal margin, defined on the zig-zag portion on both sides by a fine white line; a very fine anteciliary black thread, defined inwardly narrowly with whitish on the hindwing. *Forewing* with the inner margin broadly whitish; the large tuft of hairs turned under and forwards deep black, and lying across a polished area. *Hindwing* with a small round black spot in the first median interspace near the margin, anteriorly broadly crowned with a large orange spot which reaches as far as the submarginal dark line; the anal lobe bearing a prominent large round deep black spot, crowned with a thin line of turquoise-blue scales; the area between the anal lobe and the second median nervure broadly sprinkled with grey scales; *tails* black, fringed and tipped with white. *Body* above blue throughout; below whitish.

Closely allied to *C. cotys*, Hewitson, from Nepal, Sikkim, the Khasia Hills, East Pegu, and Burma, and to *C. anysis*, Hewitson, from Macassar (Celebes), and the Philippine and Jolo Isles, differing from the figure of the latter in the black area of the forewing on the upperside being less wide and reaching the inner angle in a regular curve, in *C. anysis* it appears to end abruptly at the first median nervure; in the latter species the apex of the hindwing appears to be blue, in *C. cremera*

it is somewhat broadly black; on the underside of the hindwing the black spot in the first median interspace is half as large, while the orange area anterior to this spot is many times larger than in *C. anysis*. From *C. cotys* it differs on the underside in the common white discal band being narrower, in the absence of the common "submarginal obscure rufous band," by the large size of the orange patch crowning the black spot in the first median interspace of the hindwing, and by the anal lobe being crowned with blue instead of orange.

Described from two male examples sent me by Mr. H. Fruhstorfer.

33. *APHNÆUS HIENDLMAYERI*, n. sp., Plate V, Fig. 5, ♀.

HABITAT: N.-E. Sumatra.

EXPANSE: ♀, 1.7 inches.

DESCRIPTION: FEMALE. UPPERSIDE, *both wings* fuscous with strong reflections in certain lights, in one light dark purple, in another ochreous-bronzy. *Hindwing*, anal angle and lobe bearing a large patch of deep red (dragon's blood) colour, this red area outwardly marked with a black line centered with a line of pure silvery scales; *tails* also deep red, but becoming black towards the end, tipped with white. UNDERSIDE, *both wings* dull brownish-ochreous, the disc somewhat mottled with deep red, profusely marked with spots of the purest metallic silvery colour. *Forewing* with the silvery spots thus:—A series of dots along the costa, the series not quite reaching the base of the wing, increasing in size as they advance towards the apex of the wing, the series not nearly reaching the apex; a large oblique streak near the middle of the discoidal cell; an upright one across its end; two spots beyond placed obliquely; an elongated curved streak below the cell divided by the second median nervule; a lengthened narrow streak lying along the first median nervule; a chain-like submarginal band—all these silvery spots narrowly outwardly defined with a black line and more broadly by deep red; a marginal deep red line; the base of the wing yellowish, the inner margin broadly whitish, becoming plumbeous at the first median nervule. *Hindwing* with sixteen silvery spots and streaks as in the forewing spread fairly evenly over the base and disc; a submarginal red band recurved to the abdominal margin, the band anteriorly slightly, posteriorly profusely, marked with silvery; a narrow deep red anteciliary line; the anal lobe deep red bearing a small black spot anteriorly crowned with yellow. *Body* above concolorous with the wings on the upperside. *Face* in front, *palpi*, body beneath, and *legs* yellow.

As far as I am aware, this species has no near ally, it does not even remotely resemble any Oriental species with which I am acquainted. In the type specimen, being a female, the upperside is not brilliantly

blue coloured as the male will probably prove to be; the rich silvery markings on a ground of an unusual shade, the markings themselves also being of a shape hitherto unknown to me, make the lower surface of this insect not only singularly beautiful but extremely different from all other Eastern species of the genus. It is possibly more nearly related to the numerous richly coloured African species allied to *Aphnaemorpha orcas*, Drury. It is not a little remarkable that while continental India is so rich in species of the genus *Aphnaeus*, [Sumatra should not possess more than one other species, the wide-spread *A. lohita*, Horsfield; while the Malay Peninsula and larger islands (Borneo and Java) should only possess two or three species, *A. lohita* and *A. syama*, Horsfield, and *A. vulcanus*, Fabricius.

Described from a unique example taken at Selesseh on 15th August, 1893, in Dr. L. Martin's collection. At his suggestion I have named it after Herr A. Hiendlmayr, the Custos of the Munich Museum, Bavaria.

34. *TAJURIA BLANKA*, n. sp., Plate IV, Fig. 4, ♀.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♀, 1.6 inches.

DESCRIPTION: FEMALE. UPPERSIDE, *forewing* with the costa at the base very narrowly, the apex very widely, the outer margin decreasingly, black; the rest of the wing rather light clear blue. *Hindwing* with the costa broadly fuscous; the apex widely, the outer margin narrowly, black; the abdominal margin as far as the submedian nervure whitish; the rest of the wing blue; the anal lobe small, black, crowned with a few blue scales, the lobe anteriorly bearing against it a white fascia; the tails rather short, black, tipped with white, the longer one from the termination of the first median nervure, the shorter from the submedian nervure. *Cilia* black throughout. UNDERSIDE, *forewing* immaculate, drab, the inner margin extending broadly on to the disc dull ochreous. *Hindwing* drab; with an irregular outer discal dark line outwardly defined by white from the abdominal margin to the third median nervure; a small oval black spot on the margin in the first median interspace; a slightly larger black spot on the anal lobe, anteriorly and posteriorly bearing some fine turquoise-blue scales; the space between and above these spots ochreous; an anteciliary black thread inwardly defined by a narrow white thread from the anal lobe to the third median nervure; *cilia* of the forewing and the anterior moiety of the hindwing drab, the posterior moiety whitish. *Body* above clothed with long hairs, of the shade of blue of the wings; *thorax* beneath drab, *abdomen* beneath dull ochreous.

Probably nearest to *T. mantra*, Felder, and *T. relata*, Distant, from

both of which *T. blanka* may instantly be known by the forewing on the underside having no markings whatever.

Described from a single example in Dr. Martin's collection, which was taken in October. Namoe Blanka is the name of a Battak kampong or village.

35. *CHARANA CEPHEIS*, n. sp., Plate V, Fig. 10, ♂.

HABITAT: Assam.

EXPANSE: ♂, 1·8 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* glossy purplish-black. *Forewing* with the basal two-thirds of the interno-median area ending outwardly in a point and the basal half of the sutural area rich deep blue of about the same shade as in the male of *Camena icetas*, Hewitson. *Hindwing* with the outer half from the second subcostal nervule to the submedian nervure, crossed by the black veins, rich deep blue; a diffused and indistinct submarginal black spot in the first median interspace; the outer margin narrowly black; the anal lobe orange-ochreous, bearing a few white and blue scales; the tails black, fringed and tipped with white. UNDERSIDE, *both wings* with the basal two-thirds pale chrome-yellow, the outer third purplish-brown. *Forewing* with the purplish-brown area bearing two macular deeper brown bands, which are farthest apart in the middle but meet at each end, thus enclosing an oval space of the ground-colour; a submarginal whitish thread reaching from the anal angle to the middle of the wing. *Hindwing*, the outer purplish-brown area bears two macular deeper brown bands, the inner one posteriorly highly zig-zag and recurved to the abdominal margin, the outer one reaching only to the second median nervule; the first median interspace bears a round black spot with an outer rust-red ring; the anal lobe is jet-black, anteriorly bearing a few turquoise-blue scales, and bearing anteriorly to these again a rust-red line, which is continued to the abdominal margin along the edge of the incised portion of the wing anterior to the anal lobe, this red line defined on both sides with a very narrow black line. *Cilia* of the hindwing narrowly tipped with white, those of the forewing black.

This species is very near to *O. mandarinus*, Hewitson, from Sikkim, Bhutan, Assam, and Burma, from which it differs in the following particulars:—The blue coloration of the upperside is quite different, being of a much darker and richer hue, in *O. mandarinus* it is distinctly "dull cerulean blue," the blue colour also does not extend into the discoidal cell of the forewing as it does in that species; on the underside the outer area of both wings is purplish-brown instead of rufous, in the forewing the macular bands touch at both ends instead of being



parallel throughout; and in the hindwing of *C. mandarinus* beyond the inner zig-zag black line from the second median nervule to the abdominal margin there is a considerable white band, this being obsolete in *C. cepheis*, the purplish-brown area being continued uninterruptedly and of equal width throughout from the apex of the wing to the anal angle.

Described from two male specimens exactly alike captured by Lieut. C. H. Ward, on Nemotha, a peak in Cachar, 3,634 feet high, on October 15th, 1892, one of which he has generously presented to me. Lieut. Ward captured *C. mandarinus* at the same time and place.

36. NEOCHERITRA NAMOA, n. sp., Plate V, Fig. 9, ♂.

HABITAT: Battak Mountains, N-E. Sumatra.

EXPANSE: ♂, 1.6 inches.

DESCRIPTION: MALE. UPPERSIDE, *forewing* and *cilia* black; a broad oblique pale non-iridescent blue band crosses the base of the wing, this area commences narrowly on the costa, crosses the discoidal cell at about its middle, meeting the median nervure at the point where the first median nervule arises, and reaches the inner margin at about two-thirds of its length from the base. *Hindwing* with the costa at the base of the wing broadly pearly shining white, bearing in its middle a large round fuscous "scale mark," this mark being placed at the base of the first subcostal nervule by which it is equally bisected, not extending into the cell, the mark shewing clearly on the under-side of the wing as a raised area: the apex of the wing reaching to the second median nervule broadly black, the rest of the wing pale non-iridescent blue shading off into pure white broadly towards the anal angle; a large round black spot placed close to the margin in the first median interspace; a similar one in the submedian interspace, but placed further from the margin; the anal lobe with a large round black spot in its middle almost hidden by overlying long white hair-like scales; an anteciliary fine black thread which extends some little distance along the middle of the two tails, the thread commences at about the first median nervule and ends at the base of the inner long tail; *cilia* anteriorly black, posteriorly pure white; outer *tail* at termination of first median nervule tipped with white, anterior to this it is black, then again white to its base, in length it is 5 mms.; inner tail at termination of submedian nervure white, in length 17 mms., or about .65 of an inch. UNDERSIDE, *both wings* pale bluish-white. *Forewing* with the costa and apex broadly dull brownish-ochreous, shading off into the white discal area; the inner margin broadly highly polished at the base; across this polished area lies a thick tuft of long dull brownish-ochreous

hairs. *Hindwing* at the apex with a short dull ochreous-brown sub-marginal line ending in the second median interspace in a narrow black line; four short black lines placed in echelon across the disc, one each in the second and first median, submedian and internal interspaces; the three large round black spots on the margin towards the anal angle as on the upperside, but larger, more prominent, and of a deeper shade, the one on the anal lobe with a black line placed against it anteriorly; between the anal lobe and the line above it are a few pale greenish metallic scales, the middle black spot also bears a few similar scales scattered over it; a fine black anteciliary thread traverses the whole length of the margin and extends as above for a short distance along the bases of the tails. *Head, thorax, and abdomen* above pale blue; beneath, *palpi* and *legs* white. The *antennæ* are very interesting—the club and shaft above are black, but the shaft beneath is pure white.

Unfortunately I possess no male specimen of the type species of the genus, *Neocheritra amrita*, Felder, with which to compare the structure of *N. namoa*. As far as I can judge, however, it comes into that genus, as it possesses four subcostal nervules and a tuft of hairs attached to the inner margin of the forewing and turned under and forwards, and the cup-like depression (as seen from above) to the hindwing mentioned by Hewitson as found in the typical species. Both Hewitson and Distant figure the male of *N. amrita*, from which *N. namoa* differs on the upperside in the forewing having the blue area of less extent, in the hindwing in having the black apical area twice as large, in both the tails being very considerably shorter, and on the underside in having the apical area of the forewing dull brownish-ochreous, not deep fulvous or reddish-ochreous. I have female specimens of *N. amrita* from Perak, Singapore, and Sumatra. To this genus probably belongs the very distinct "*Sithon*" *teunga*, Grose Smith, from Borneo.* Another allied species is "*Hypolycaena*" *clælla*, Weymer,† from the Island of Nias, of which I possess a female specimen. It has much shorter tails than *N. namoa*, and the discal series of black spots on the underside of the hindwing instead of being placed in echelon are arranged in a straight line, as they are also in *N. amrita*. The ground-colour of the two species on the underside agrees exactly, but *N. clælla* (the species is a true *Neocheritra*) has the dull brownish-ochreous coloration more extensive on the forewing. Probably still another allied species (which I have not seen) is "*Sithon*" *paluana*, Staudinger, from Palawan in the Philippines.‡

Described from an unique specimen taken on 21st May, 1893, in the

* Ann. and Mag. of Nat. Hist., sixth series, vol. iii, p. 317 (1889).

† Stet. Ent. Zeit., vol. xlviii, p. 10, n. 8, pl. ii, fig. 5, female (1887).

‡ Iris, vol. ii, p. 107, pl. i, fig. 9, female (1889).



Battak mountains, deposited in Dr. Martin's collection. I have taken its name from Namoe Oekor and Namoe Blanka, two Battak villages.

37. *SINTHUSA MALIKA*, Horsfield, Plate V, Figs. 18, ♂; 6, ♀.

Thecla malika, Horsfield, Cat. Lep. E. I. Co., p. 90, n. 22 (1829); *Dipsas malika*, Horsfield and Moore, Cat. Lep. Mus. E. I. Co., vol. i, p. 37, n. 43, pl. ia, fig. 5, male (1857); *Myrina malika*, Hewitson, Ill. Diurn. Lep., p. 37, n. 34, pl. xv, figs. 41-43, male (1863); *Sithon malika*, Kheil, Rhop. Nias., p. 32, n. 112 (1884); *Sinthusa malika*, de Nicéville, Butt. of India, vol. iii, p. 487 (1890); *Sinthusa amata*, Distant, Rhop. Malay., p. 461, n. 2, pl. xlv, fig. 20, female (1886); id., de Nicéville, Butt. of India, vol. iii, p. 488 (1890).

HABITAT: Java (*Horsfield, Moore, Hewitson, coll. de Nicéville*); Sumatra (*Hewitson, coll. de Nicéville*); Nias (*Kheil*); Penang (*Distant, coll. de Nicéville*); Perak (*coll. de Nicéville*).

EXPANSE: ♂, 1.00 to 1.15; ♀, 1.2 inches.

DESCRIPTION: MALE. UPPERSIDE, *forewing* deep indigo-blue, viewed from the side iridescent rich ultramarine-blue; the costa and outer margin narrowly black, broadly black at the apex. *Hindwing* much lighter blue than on the forewing, not iridescent, the costa broadly black, the abdominal margin broadly fuscous. *Cilia* of the forewing black, of the hindwing pure white, except at the apex of the wing, where they are fuscous. UNDERSIDE, *both wings* white with a bluish shade, the markings brownish-ochreous. *Forewing* with the costa narrowly, the apex widely, the outer margin fining away to nothing at the inner angle, brownish-ochreous; an oblong broad spot at the end of the discoidal cell; a discal macular band consisting of six increasing spots, the band strongly broken in the middle, the three posterior portions of the band shifted towards the base of the wing; an obscure submarginal macular fascia from the submedian nervure, becoming lost anteriorly in the dark apical area. *Hindwing* with a broad oblong spot at the end of the cell; eight small discal spots arranged in pairs irregularly across the wing from the costa to above the anal angle; a round black spot in the first median interspace on the margin; a black spot in the submedian interspace sprinkled with metallic-blue scales; a double series of small lanules on the outer margin between the spot in the first median interspace and the apex of the wing, obsolete in a Javan specimen; the small anal lobe black, crowned with metallic-blue scales. *Cilia* of the forewing brownish-ochreous; of the hindwing white, with a fine black anteciliary thread. *Tail* white with a black central line. The tuft of hairs attached to the inner margin of the forewing towards the base and turned under and upwards, large and black. FEMALE. UPPERSIDE, *both wings* shining hair-brown. *Forewing* unmarked. *Hindwing* with an outer white area,

separated from the outer margin by a narrow band of the ground-colour, the white area commences narrowly at the second subcostal nervule, increases in width to the abdominal margin; a narrow black anteciliary thread from the anal angle to the third median nervule. **UNDERSIDE**, *both wings* with the markings similar to those in the male, but of a pure ochreous shade margined with fuscous. *Forewing* with the apex also pure ochreous. The tail twice as long and twice as broad as in the male.

My single Javan male specimen here figured has the blue coloration of the upperside of the forewing more extensive, the markings of the underside smaller,* the double marginal macular bands obsolete in the hindwing, the brownish-ochreous apical area of the forewing more restricted than in my numerous specimens from the Malay Peninsula and the Battak Mountains of Sumatra, but as all these features seem to be somewhat variable in my series of specimens, I think the *S. amata* of Distant should fall before *S. malika* of Horsfield.

The figure of the male is taken from my Javan specimen, that of the female from a Penang example. I have also figured, Plate V, Fig. 17, the unique type male specimen of *Sinthusa aspra*, Doherty (Journ. A. S. B., vol. ix, pt. 2, p. 180 (1891), from Mount Arjuno, 5,000 feet, Eastern Java, the specimen being in my collection.

Family PAPILIONIDÆ.

Subfamily PIERINÆ.

38. *DELIAS DYNAS*, n. sp., Plate V, Fig. 7, ♂.

HABITAT: Java.

EXPANSE: ♂, 2·6 inches.

DESCRIPTION: **MALE.** **UPPERSIDE**, *forewing* black; the disco-cellular nervules marked on each side with a white line; a submarginal series of six white streaks; a small patch of grey scales at the base of the first median interspace, a much larger one below this in the submedian interspace. *Hindwing* with the extreme base, the costa, and the outer margin black, the rest of the wing white, but the area between the abdominal margin and the second median nervule tinted with primrose-yellow. **UNDERSIDE**, *forewing* as on the upperside, but the grey patches on the disc smaller. *Hindwing* with the base broadly black, bearing a broad crimson patch, the disc of the wing rich chrome-yellow crossed by the narrow black veins, the outer margin black, that colour ascending the veins on either side for some little distance.

* Noted also by Hewitson.



Nearest to *D. crithoë*, Boisduval, also from Java, but differing in the submarginal series of spots on the forewing being twice as numerous, and all the disco-cellular nervules, instead of the lower one only, defined on each side with a white line; the hindwing has the white and pale yellow area much larger, thereby reducing the outer black area by one-half. Also near to *D. tobahana*, Rogenhofer, = *D. derceto*, mihi, from Sumatra, but that species lacks the two discal patches of grey scales on the forewing, has the white and yellow area on the hindwing smaller, and on the underside has the crimson band of the hindwing at least twice as broad.

Described from a single example collected by Mr. W. Doherty in Java and given to me by him as a new species. After the description above was written and the specimen figured, I received Herr Fruhstorfer's description of *D. bromo*,* also from Java, from which *D. dymas* appears to differ mainly in the entire absence of the crimson base to the hindwing on the upperside.

Subfamily PAPILIONINÆ.

39. *PAPILIO* (*Pangerana*) *HAGENI*, Rogenhofer, Plate IV, Fig. 6, ♂.

Papilio hageni, Rogenhofer, Verh. zool.-bot. Gesellsch. Wien, vol. xxxix, p. 1 (1889); id., de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. viii, p. 55, n. 16, pl. M, fig. 2, female (1893).

HABITAT: Sumatra.

EXPANSE: ♂, 5.6 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* rich glossy black. *Forewing* with some paler streaks in the discoidal cell and between the veins. *Hindwing* with a large white patch occupying the outer half of the wing, anteriorly bounded by the second subcostal nervule, posteriorly extending just beyond the greatly curved first median nervule, not reaching the outer margin, this latter bearing four large conjoined lunular black spots; the white area bears outwardly four large round black spots, the three anterior ones equal-sized, the posterior one smaller; the white area between these last-mentioned four spots and the four black lunular spots on the margin sprinkled with black scales; the abdominal margin is as usual twice folded over, and is lined within with a white flocculent substance, the edge of the fold within being rose-pink. UNDERSIDE, *forewing* paler than on the upperside. *Hindwing* as above, except that the white area has no black sprinkling, and that there is a small white spot at the posterior end of the cell, with three similar ones in the first subcostal interspace, these latter

* *Delias bromo*, Fruhstorfer, Ent. Nach., vol. xix, p. 335 (1893).

really forming an incomplete white edging to a fifth discal black spot. *Antennæ* black. *Head* in front and *thorax* anteriorly pale buff-yellow, *thorax* and *abdomen* above black, *thorax* beneath and *legs* black, *abdomen* beneath rich crimson, cross-banded with black, and bearing on each side a series of small black spots; *anal valves* black.

Described from a single male taken on 5th May, 1893, and generously given to me by Hofrath Dr. L. Martin, who possesses one other male in his magnificent collection.

40. *PAPILIO* (*Menamopsis*) *PERSES*, n. sp., Plate IV, Fig. 7, ♂.

HABITAT: Gayoes Mountains, N.-E. Sumatra.

EXPANSE: ♂, 3.7 inches.

DESCRIPTION: MALE. *UPPERSIDE*, both wings fuscous. *Forewing* with the basal two-thirds very dark fuscous, the outer third lighter. *Hindwing* with a submarginal series of sullied-white streaks placed in pairs between the veins, reaching neither the outer margin nor the discoidal cell, most prominent at the anal angle, becoming obsolete towards the apex of the wing; a small round chrome-yellow spot outwardly surrounded by a black line at the extreme anal angle. *UNDERSIDE*, both wings uniformly pale fuscous. *Forewing* immaculate. *Hindwing* with the anal spot as on the upperside; the submarginal series of white streaks longer, reaching almost to the outer margin, wider and clearer white. *Head* and *thorax* in front black, spotted with white, rest of *thorax* and *abdomen* black, the latter bearing three series of white spots on each side, the *anal valves* white, edged with black.

Mr. W. F. Kirby has kindly compared the drawing here reproduced with the specimen of *P. hewitsonii*, Westwood, in the British Museum, which is probably the type of that species, and was figured by Mr. Hewitson in his "Exotic Butterflies," vol. ii, *Papilio* pl. iv, fig. 9, (1859) as the female of *P. slateri*, Hewitson. Mr. Kirby informs me that the species here described is quite distinct from the Bornean *P. hewitsonii*. The latter I have not seen, but from Hewitson's figure of it, which he says is taken from a female (Wallace, however, says the specimen is a male,* as also does Westwood,† again Mr. G. O. Dudgeon has examined it and tells me that it is, with two other specimens in the British Museum, undoubtedly a male), it differs in having the outer third of the forewing lighter coloured than the rest of the wing instead of concolorous throughout; the hindwing with a prominent submarginal series of white streaks, instead of, as in *P. hewitsonii*, "two rows

* Trans. Linn. Soc. Lond., vol. xxv, p. 61, n. 86 (1864).

† Proc. Ent. Soc. Lond., third series, vol. ii, p. 10 (1864).

of indistinct white spots, in pairs, between the median nervules near the outer margin" on the upperside, those on the underside are said to form "two rows, united into distinct hastate spots pointed inwards." The chrome-yellow anal spot in *P. perses* is half the size of that in *P. hewitsonii*, and the wings of my specimen are also narrower.

Described from a single example in my collection received from Hofrath Dr. L. Martin, who has other specimens in his own collection. It is a perfect mimic—except for the chrome-yellow anal spot to the hindwing—of *Euploea* (*Penoa*) *ménétrièrii*, Felder, which is found flying with it.

41. *PAPILIO* (*Menamopsis*) *PETRA*, n. sp., Plate IV, Fig. 5, ♂.

HABITAT: Gayoes Mountains, N.-E. Sumatra.

EXPANSE: ♂, 4.1 inches.

DESCRIPTION: MALE. UPPERSIDE, *forewing* fuscous, the area at the anal angle broadly paler; a curved discal series of eight inwardly-pointed white streaks placed one each between the veins; the series anteriorly well removed from the outer margin of the wing, approaching the anal angle posteriorly; the spots forming the series largest anteriorly, rapidly decreasing in size posteriorly; each spot bisected longitudinally by the internervular fold. *Hindwing* fuscous at the base only, the rest of the wing much paler; a submarginal series of sullied-white streaks placed in pairs between the veins, well removed from the outer margin except the two anteriormost ones, which approach it closely; a small round chrome-yellow spot placed on the anal angle, anteriorly crowned with a black lunule. UNDERSIDE, *both wings* concolorous, shining pale fuscous. *Forewing* with the discal series of white streaks smaller and becoming obsolete. *Hindwing* with the submarginal series of white streaks more prominent, each streak whiter, larger, and almost reaching the outer margin. *Head* and *body* as usual.

Closely allied to *P. hewitsonii*, Westwood, from Borneo, and *P. perses*, de Nicéville, from the Gayoes Mountains of N.-E. Sumatra. From both it differs in its larger size, and in the presence of the conspicuous discal series of white streaks on the upperside of the forewing. It differs from *P. hewitsonii* in having the submarginal series of white streaks on the hindwing, these being obsolete or absent in that species; the anal spot is also very much smaller in *P. petra*.

Described from an unique example in the collection of Hofrath Dr. L. Martin, brought down from the mountains by his Gayoes collectors in January, 1893.

Family HESPERIIDÆ.

Genus CHARMION, nov.

MALE. FOREWING, triangular, entire; *costa* gently arched; *apex* rather acute; *outer margin* very straight in general direction, slightly convex; *inner margin* straight, in length equal to the outer margin; *costal nervure* ending opposite the apex of the discoidal cell; *first subcostal nervule* arising nearly twice as far from the second subcostal as that vein does from the third; *fourth* and *fifth* subcostals arising close together; *upper disco-cellular nervule* stout, long, strongly outwardly oblique; *middle* and *lower disco-cellulars* thin, gently curved, concave, placed inwardly obliquely, the lower slightly longer than the middle, consequently the *lower discoidal nervule* lies nearer to the upper discoidal than to the third median nervule; *discoidal cell* reaching to a little less than two-thirds the length of the wing* from the base; *second median nervule* arising far from the lower end of the cell; *first median* arises near the base of the wing, with its base further from the base of the second median than that vein arises from the third; *submedian nervure* slightly sinuous. HINDWING, entire; *costa* much arched at base, then nearly straight; *apex* rather acute; *outer margin* regularly curved to the abdominal margin, slightly produced at the termination of the second median nervule, between the second median nervule and the anal angle slightly concave; *costal nervure* nearly straight, ending at the apex of the wing; *first subcostal nervule* arising far before the apex of the cell; *disco-cellular nervules* slightly outwardly oblique; *upper disco-cellular* sinuous; *lower disco-cellular* concave, slightly longer than the upper; *discoidal nervule* well developed; *second median nervule* arising well before the lower end of the cell; *first median* arising twice as far from the second, as the second arises from the third; *submedian* and *internal nervures* straight. ANTENNÆ with a well-developed club, the thin apical portion of which is directed at right-angles to the shaft. PALPI erect, pressed close to the face, densely pilose, third joint hidden beneath the hairs. ABDOMEN reaching to the level of the outer margin of the wing. LEGS. *Foreleg* with an epiphysis on the tibia. *Hindleg* with a long tuft of hairs attached to the tibia at its base, and two pairs of spines towards its apex. FEMALE. Differs from the male in the wings being slightly rounder and fuller, and lacking the tuft of hairs on the hindleg. Type, *C. ficulnea*, Hewitson.

* Lieut. E. Y. Watson, in Proc. Zool. Soc. Lond., 1893, pp. 15 and 16, divides his subfamily *Hesperiniæ* into Sections A and B by the discoidal cell of the forewing being more or less than two-thirds the length of the costa. This is a measurement which I find very difficult to verify.

Charmion differs from *Hantana*, Moore, in the discoidal cell of the forewing being a little less than two-thirds the length of the wing, in *Hantana* the cell is obviously more than two-thirds the length. It differs from both *Hantana*, Moore, and *Celænorrhinus*, Hübner, in having the middle and lower disco-cellular nervules of the forewing considerably more upright, and the second median nervule arising far from instead of close to the lower end of the cell. The imago rests on the underside of leaves with wide-spread wings.

(1) *CHARMION FICULNEA*, Hewitson.

Hesperia ficulnea, Hewitson, *Descr. Hesperidæ*, p. 37, n. 33 (1868); — *ficulnea*, Watson, *Proc. Zool. Soc. Lond.*, 1893, p. 113; *Plesioneura signata*, Druce, *Proc. Zool. Soc. Lond.*, 1873, p. 360, n. 3, pl. xxxiii, fig. 8; *Notocrypta signata*, de Nicéville, *Journ. Bomb. Nat. Hist. Soc.*, vol. iv, p. 191, n. 14 (1889); idem, id., l. c., vol. vi, p. 380, n. 26 (1891).

HABITAT: Borneo (*Hewitson* and *Druce*); Victoria Point, Lower Tenasserim; Perak, Malay Peninsula; Siam; N.-E. and S.-W. Samatra; S.-E. Borneo (*de Nicéville*).

(2) *CHARMION TOLA*, Hewitson.

Plesioneura tola, Hewitson, *Ann. and Mag. of Nat. Hist.*, fifth series, vol. i, p. 340 (1878); *Notocrypta tola*, de Nicéville, *Journ. Bomb. Nat. Hist. Soc.*, vol. iv, p. 191, n. 15 (1889); *Plastingia ? plesioneuræ*, Staudinger, *Ex. Schmiett.*, p. 299, pl. c, female (1888).

HABITAT: Tondano (*Hewitson*); Minahassa, Celebes (*Staudinger*).

I have not seen the "*Plesioneura*" *tola* of Hewitson. From the description it appears to differ from *C. ficulnea*, Hewitson, in the forewing in the discal band extending posterior to the first median nervule, in *C. ficulnea* it ends on that vein. I have put *P. tola* in the genus on Lient. E. Y. Watson's authority. Neither have I seen Dr. Staudinger's "*Plastingia ?*" *plesioneuræ*, but as the figure agrees exactly with Hewitson's description, I have no hesitation in placing it here.

Genus *SEPA*, nov.

MALE. FOREWING, *costa* almost straight; *apex* acute; *outer margin* almost straight, very oblique; *inner margin* straight, exactly as long as the outer margin; *costal nervure* ending a little before the apex of the discoidal cell; *subcostal nervules* arising at gradually decreasing distances apart; *discoidal cell* long, extending beyond the middle of the wing; *upper disco-cellular nervule* short, straight, outwardly oblique; *middle and lower disco-cellulars* of nearly equal length, straight, strongly inwardly oblique, the middle a little longer than the lower; *second median nervule* arising a little before the lower end of the cell; *first median* arising nearer the base of the wing than the lower end of the cell; *submedian nervure* straight; a sexual brand, or "male-mark,"

extends obliquely across the submedian and first median interspaces and ends anteriorly on the second median nervule a little in front of its origin. **HINDWING**, *costa* greatly arched at the base, thence straight to the apex; *apex* rather acute; *outer margin* evenly and regularly convex to the anal angle; *anal angle* very acute; *abdominal margin* straight; the wing extends a little beyond the apex of the abdomen; the cilia towards the anal angle very long; *costal nervure* ending at the apex of the wing; *first subcostal nervule* arising long before the apex of the cell; *disco-cellular nervules* almost in one straight line, outwardly oblique, the upper a little longer than the lower; *discoidal nervule* obsolete, but its position is indicated, were it to be present, by a fold in the wing membrane, and by this fold the relative length of the disco-cellular nervules is given; *second median nervule* arising just before the lower end of the cell; *first median* arising about four times as far from the second as the second does from the third; *submedian* and *internal nervures* straight. **LEGS.** *Hindleg* with two pairs of spines on the tibia.

Sepa is nearest allied to *Matapa*, Moore, from the type species of which it may be at once known by the discoidal cells of both wings being more truncate at the end owing to the disco-cellular nervules being less strongly oblique; the shape of the wings differs also, the inner margin of the forewing in *Matapa* is longer than in *Sepa*, consequently the outer margin in the former is less oblique than in the latter; the hindwing differs in that, in *Matapa*, the anal angle appears to be somewhat produced owing to the wing about the termination of the first median nervule being somewhat emarginate, in *Sepa* the wing is evenly curved throughout. Type, *Sepa cronus*, de Nicéville.

42. *SEPA CRONUS*, n. sp., Plate V, Fig. 4, ♂.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♂, 1.7 inches.

DESCRIPTION: **MALE.** **UPPERSIDE**, *both wings* rich dark shining brown. *Forewing* with three pale ochreous dots, two subapical, the anterior one most minute, the third in the second median interspace about twice the size of the lower subapical spot; a narrow obscure discal black stigma or "male-mark" crossing obliquely the submedian and first median interspaces, that portion of the stigma in the latter interspace having a prominent pale ochreous semi-transparent line placed outwardly against it. *Hindwing* immaculate. **UNDERSIDE**, *both wings* exactly as above except that the ground-colour is dull, not shining. *Cilia* concolorous with the wings throughout, those of the hindwing at the anal angle unusually long, though not quite as long as in *Lophoides iapis*, de Nicéville, from Burma, the Malay Peninsula, Sumatra, Java,



and Pulo Laut. *Antennæ* black, the club beneath, except the extreme tip, ochreous. *Eyes* with a band of dull ochreous setæ encircling them. *Body* concolorous with the wings throughout.

Described from a single example from the Battak Mountains taken in September, and deposited in Dr. Martin's fine collection.

Genus OCHUS, nov.

MALE. FOREWING, entire; *costa* strongly and evenly arched throughout its length; *apex* somewhat rounded; *outer margin* strongly convex; *inner margin* considerably longer than the outer margin, nearly straight, slightly concave in the middle; *costal nervure* ending opposite the apex of the discoidal cell; *subcostal nervules* very long owing to the highly arched costa, arising progressively from the base of the wing at decreasing distances apart; *discoidal cell* broad, short, extending to a little beyond the middle of the wing; *upper disco-cellular nervule* long, straight, slightly outwardly oblique; *middle* and *lower disco-cellulars* of equal length, a little longer than the upper, directed inwardly slightly obliquely, the middle concave, the lower straight; *lower discoidal nervule* lying midway between the upper discoidal and third median nervules; *second median nervule* arising well before the lower end of the cell; *first median* arising nearer the lower end of the cell than the base of the wing; *submedian nervure* nearly straight. HINDWING, entire, oval; *costa* arched; *outer margin* evenly rounded to the anal angle; *abdominal margin* short, nearly straight; *costal nervure* short; *first subcostal nervule* arising a short distance before the apex of the cell; *discoidal cell* short, less than half the length of the wing; *disco-cellular nervules* concave, placed slightly outwardly obliquely; *discoidal nervule* absent; *second median nervule* arising very close to the lower end of the cell; *first median* arising nearer the lower end of the cell than the base of the wing; *submedian* and *internal nervures* straight, the latter rather short. ANTENNE short, less than half the length of the costa of the forewing; club rather slender, long, straight, ending regularly and evenly in a point. PALPI rather thinly and laxly clothed with hairs, porrected forwards in front of the face; third joint rather long, hairy. THORAX weak, small. ABDOMEN very slender, long, extending beyond the anal angle of the hindwing. Male with no secondary sexual characters. FEMALE differs from the male only in its broader and more rounded wings. LEGS. *Foreleg* with an epiphysis on the tibia. *Hindleg* with two pairs of spines on the tibia. Type, *O. subvittatus*, Moore.

Ochus apparently finds its place amongst the final genera of Lieut. E. Y. Watson's subfamily Pamphilinæ, Section A (Proc. Zool. Soc. Lond., 1893, p. 72), which contains the genera *Argopteron*, Watson,

Heteropterus, Dumeril, *Pamphila*, Fabricius, and *Cyclopides*, Hübner. *Ochus* is apparently nearest to *Pamphila*, of which the type is *P. palæmon*, Pallas, and from which it is abundantly distinct; the costa of the forewing is greatly arched instead of straight, the apex is rounded instead of being acute, the outer margin is more rounded, the discoidal cell is much shorter and broader; the hindwing is more oval, the discoidal cell is again much shorter, the discoidal nervule is obsolete, in *P. palæmon* it is present; besides many other minor differences. The imago rests with wings closed over its back. Of all the Indian species of *Hesperiidæ*, *O. subvittatus* probably has the feeblest flight, appearing on the wing to be a dark-coloured, low-flying lycaenid, similar to a female of the wet season form of *Zizera maha*, Kollar, or some other dark-coloured "blue." Lieut. Watson suggests in Proc. Zool. Soc. Lond., 1893, p. 97, that "*Cyclopides*" *subvittatus* belongs to the North American genus *Ancyloxypha*, Felder, or to one closely allied to it; but this is not the fact, *Ochus* is widely distinct from that genus, and comes into the first section of the subfamily instead of the second containing the genus in question.

(1). *OCHUS SUBVITTATUS*, Moore.

Cyclopides subvittatus, Moore, Proc. Zool. Soc. Lond., 1878, p. 692; id., Wood-Mason and de Nicéville, Journ. A. S. B., vol. lv, pt. 2, p. 392, n. 249, pl. xvii, figs. 6, 6a, male, × 2 (1886); id., Elwes, Trans. Ent. Soc. Lond., 1888, p. 453, n. 487; *Cyclopides subradiatus*, Moore, Proc. Zool. Soc. Lond., 1878, p. 693.

HABITAT: Darjeeling; Salween district, Moulmain, Burma (*subvittatus*); Khasia Hills (*subradiatus*, Moore); Kumaon (*Doherty*); Sikkim, Bhutan, Assam, Burma (*coll. de Nicéville*).

It is, I think, quite impossible to separate *O. subradiatus* from *O. subvittatus*. Mr. Moore places the former in the middle of the region inhabited by *O. subvittatus*. I have caught it as far south as the Dawnat range and Meplé in Middle Tenasserim, in the month of October.

43. *ERYNNIS DIMILA*, Moore, Plate I, Fig. 7, ♂.

Pamphila dimila, Moore, Proc. Zool. Soc. Lond., 1874, p. 576; id., de Nicéville, Journ. Bomb. Nat. Hist. Soc., vol. vii, p. 355, n. 23, pl. J, fig. 9, female (1892); *Erynnis comma*, var. *dimila*, Leech, Butt. from China, Japan, and Corea, p. 595, pl. xli, fig. 12, male (1893).

HABITAT: Runang Pass, south-east side, about 13,000 feet elevation, Busahir (Moore); Khibber Nala, about 16,000 feet elevation, Spiti (*Sage*); Ganges Valley, near Nilung Pass, 16,000 feet, August, 1893 (*Mackinnon*); Ta-chien-lu, Western China (*Leech*).

As I have already figured the female of this rare species, I now take the opportunity to figure the male. Mr. P. W. Mackinnon through his native collectors obtained three male specimens, of which he has

generously presented me with two. The species appears to me to come into the genus *Erynnis* of Schrank, of which the type is *E. comma*, Linnæus, the British "Small Skipper." The shape and markings of the two species is very similar, but the male of *E. dimila* has the ochreous ground-colour of the upperside much more extensive than in *E. comma*, especially so on the hindwing; the spots on the underside of both wings are also more prominent, larger, and whiter than in *E. comma*. The club of the antenna is somewhat differently shaped, the terminal portion or apex in *E. dimila* being considerably longer than in *E. comma*.

Since the above was in type, I have received Part V of Mr. Leech's "Butterflies from China, Japan, and Corea," in which a single male of *E. dimila* is recorded from Western China and duly figured. If this specimen is really typical (the plate in which it is figured has not as yet been published), it greatly extends the range of the species. Mr. Leech considers *E. dimila* to be a "var." only of *E. comma*, Linnæus, and records the parent species from Europe, Amurland, Corea, Japan, N.-W. Himalayas, N. and W. China.

44. *PADRAONA PAVOR*, n. sp., Plate IV, Fig. 8, ♂.

HABITAT: Battak Mountains, N.-E. Sumatra.

EXPANSE: ♂, 1.2 to 1.3 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* shining black tinged with bronzy. *Cilia* golden-orange, broadest towards the anal angle of the hindwing, gradually becoming dusky as the apex of the forewing is reached in some specimens. *Forewing* with an orange streak on the basal two-thirds of the costa, widening out at the end of the discoidal cell, crossed by the black costal and subcostal veins; an orange streak on the basal two-thirds of the inner margin; a discal straight series of seven orange spots, extending from the costa to the submedian nervure, the series broken between the third and fourth spots from the costa; the three uppermost spots linear, small, increasing; the fourth in the second median interspace quadrangular; the fifth in the first median interspace also quadrangular, but twice as large as the one anterior to it; two spots in the submedian interspace, the anterior one very small. *Hindwing* with some orange streaks from the base reaching to the middle of the wing formed of long setæ; a transverse band of five orange spots across the middle of the disc. UNDERSIDE, *both wings* rich dark brownish-orange. *Forewing* with the posterior half black; a prominent oblique orange-yellow streak at the end of the cell; the discal series of spots as above, except that the four posterior ones are larger than on the upperside, the two posteriormost conjoined. *Hindwing* with a curved discal series of five spots, the four anterior ones are

of a slightly lighter shade than the ground-colour, outwardly defined by a very narrow black line, the fifth posterior spot the largest and of a bright yellow colour, with another somewhat diffused spot beyond reaching the outer margin; a black anteciliary thread from the apex of the wing to the first median nervule.

This appears to be a very distinct species, differing from all others of the genus known to me (*Padraona dara*, Kollar, = *P. mæsa*, Moore; *P. mæsoides*, Butler; *P. pseudomæsa*, Moore; *P. gola*, Moore; *P. goloides*, Moore; *P. augiades*, Felder; *P. olivescens*, Herrich-Schäffer; *P. palmarum*, Moore; *P. procles*, de Nicéville) in lacking in the forewing on the upperside the two spots divided by the lower discoidal nervule invariably present in all those species. It agrees with *P. procles* and *P. olivescens* in having no spots in the hindwing anterior to the discal band towards the costa and base of the wing. It possesses, moreover, a male-mark, which is, I believe, unique in the genus, consisting of a shining pale silky streak to be seen in some lights only on the upperside of the forewing placed within the discal band of spots in the lower median and submedian interspaces. I may add that the entire coloration of the species is very dark and rich.

Described from numerous specimens in Dr. L. Martin's collection and my own, some of which were taken in June.

45. HALPE HIERON, D. sp., Plate IV, Fig. 1, ♂.

HABITAT: N.-E. Sumatra.

EXPANSE: ♂, 1.15 to 1.25 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* shining hair-brown. *Forewing* with, in some specimens, two exceedingly obscure pale spots in the median interspaces, placed obliquely as usual in the genus, the lower one nearer the base of the wing than the upper; in some specimens these spots are entirely absent; no "male-mark." *Hindwing* immaculate. UNDERSIDE, *forewing* with the inner margin broadly pale fuscous, the rest of the wing dull ochreous-grey; the two median spots sometimes present on the upperside always present, conspicuous, whitish; a very obscure submarginal series of pale spots in a curved series from the costa to about the first median nervule; a very fine anteciliary dark thread. *Hindwing* pale fuscous, heavily irrorated throughout with dull ochreous-grey scales. *Cilia* of the forewing sometimes faintly checkered, more often concolorous with the wing, on the hindwing always concolorous. *Antennæ* black, the base of the club beneath pale ochreous. *Palpi*, *thorax*, and *abdomen* above hair-brown; *palpi*, *thorax*, and *abdomen* beneath dull ochreous-grey.

This dull-coloured, obscurely-marked species is evidently allied

to *Halpe homolea*, Hewitson (*H. sikkima*, Moore), from which it may instantly be known by the upperside being practically spotless, and the underside but very faintly instead of prominently marked. It has also no discal stigma on the upperside of the forewing in the male.

Described from numerous specimens in Dr. Martin's and my collections taken at Bekantschan in August and September, and in the Battak Mountains, in August, both in N.-E. Sumatra.

46. KERANA FULGUR, n. sp., Plate I, Fig. 6, ♀.

HABITAT: Selesseh, N.-E. Sumatra.

EXPANSE: ♂, ♀, 1.7 inches.

DESCRIPTION: FEMALE. UPPERSIDE, both wings dark shining purplish-fuscous. Cilia concolorous. Forewing with a broad discal orange fascia, anteriorly not quite reaching the costa, posteriorly ending on the submedian nervure. Hindwing immaculate. UNDERSIDE, both wings with the ground-colour duller than on the upperside. Forewing with the apex faintly dusted with ochreous scales; the discal orange band more extensive than on the upperside, reaching the inner margin, where it is much paler, the edges of the band more irregular. Hindwing unmarked, except by the following steel-blue spots, which can be seen in all lights, but are more prominent in some lights than in others:—An elongated one closing the discoidal cell, one in the first median interspace about its middle, and three in the submedian interspace at about equal distances apart. Antennæ black above, the club beneath ochreous. Palpi black above, beneath chrome-yellow. Eyes encircled by a band of chrome-yellow. Head, thorax, and abdomen above fuscous; abdomen beneath with six ochreous lines.

Nearest to *K. gemmifer*, Butler,* (which also occurs in N.-E. Sumatra, as well as in Perak and Malacca, I have taken it on the Penang Hill at 2,200 feet elevation above the sea, in November), from the same sex of which it differs in being larger, the ground-colour of the upperside darker, the gem-like spots of the underside quite different, and the abdomen beneath striped with ochreous instead of being concolorous. The "gems" of *K. gemmifer* have never been described in detail. Mr. Butler refers to them thus:—"End of cell and apical area of primaries and disk of secondaries [on the underside] spotted, in certain lights, with shining amethyst-coloured spots" in both sexes. They are thus disposed:—Forewing with an elongated one placed on the fold in the middle of the discoidal cell just anterior to the inner edge of the discal orange fascia; three subapical ones placed one above the other,

* *Astictopterus gemmifer*, Butler, Trans. Linn. Soc. Lond., Zoology, second series, vol. i, p. 555, n. 3 (1877).

divided by the veins; *hindwing* with from four to six placed one each between the veins in a curve beyond the end of the cell. It is doubtful if Mr. Distant recognised the species, as he makes no mention* of the "gems," and his figure of the species does not shew them, nor does it agree with my specimens of *K. gemmifer*, the orange band on the underside of the forewing in true *K. gemmifer* being almost of equal width throughout, while in Mr. Distant's figure the costal portion is much narrowed and constricted. Lieut. Watson, indeed, says† that Mr. Distant's *K. gemmifer* equals *Koruthaialos xanites*, Butler, which is probable enough, that species being infinitely more common than *K. gemmifer*, the latter occurring very sparingly.

A single example of *K. fulgur*, now in Dr. Martin's collection, was taken by myself in the splendid virgin forest at Selesseh, in the Langkat district of N.-E. Sumatra, on 31st October, 1893. Since this specimen was drawn and the plates illustrating this paper made up, Dr. Martin sent me in a letter a male of *K. fulgur*. I hope to figure and describe it fully hereafter. It greatly differs from the female on the upperside in the orange fascia of the forewing being much paler, more chrome-yellow in shade, larger, and posteriorly continued almost to the base of the wing; and the base of the hindwing and base of the abdomen are clothed with long chrome-yellow setæ.

47. *PLASTINGIA VERMICULATA*, Hewitson, Plate V, Fig. 15, ♂.

Hesperia vermiculata, Hewitson, Ann. and Mag. of Nat. Hist., fifth series, vol. i, p. 316 (1878).

HABITAT: N.-E. Sumatra.

EXPANSE: ♂, 1·7 inches.

DESCRIPTION: MALE. UPPERSIDE, *both wings* black. *Forewing* with the following opaque chrome-yellow markings:—A narrow subcostal streak extending from the base of the wing to about its middle, a similar but shorter and broader streak in the submedian interspace; with the following semi-transparent yellow spots:—Two very narrow and small ones placed obliquely towards the end of the discoidal cell, the upper the larger, furthest from the base of the wing, the lower minute; a dot in the lower discoidal interspace; a spot four times as large in the second median interspace; a very large spot in the first median interspace. *Cilia* black. *Hindwing* with a basal streak of long chrome-yellow hairs which runs into a broad transverse fascia of the same colour placed in the middle of the wing; the anal area very broadly chrome-yellow, which area rapidly fines away to nothing at about

* *Kerana gemmifer*, Distant, Rhop. Malay., p. 403, n. 2, pl. xxxiv, fig. 29 (1886).

† Proc. Zool. Soc. Lond., 1893, p. 77.

the termination of the third median nervule; a streak of chrome-yellow placed in the submedian interspace springs from the base of the wing and runs into the yellow anal area; the abdominal margin and *cilia* chrome-yellow. **UNDERSIDE**, *forewing* fuscous; the costa, discoidal cell, apex and outer margin decreasingly to the anal angle streaked with chrome-yellow; the five semi-transparent spots as above; a broad, short, chrome-yellow streak towards the base of the wing in the submedian interspace; a pale blue slightly iridescent streak just beyond the end of the cell in the upper discoidal interspace. *Hindwing* chrome-yellow, with the following black markings:—The costa at the base of the wing, two subcostal streaks from the base to the apex of the wing, the posterior of these interrupted towards its end; a streak in the subcostal interspace also outwardly interrupted; a streak in the cell; a very broad one twice interrupted in the submedian interspace; a rather obscure streak in the internal interspace, extending from the base to a little beyond the middle of the wing; three small spots on the disc between the veins: also with the following pale blue slightly iridescent elongated spots:—Two in the discoidal cell, and a series of eight others extending right round its outer end. *Antennæ* black, club prominently chrome-yellow above, the apex black. *Palpi* black above, yellow beneath. *Thorax* above black clothed with long yellow hairs. *Abdomen* black, ringed with yellow. *Legs* yellow.

The nearest ally to *P. vermiculata* appears to be the "*Hesperia*" *flavescens* of Felder (Reise Novara, Lep., vol. iii, p. 517, n. 905, pl. lxxii, figs. 7, *male*; 8, 9, *female*, 1867), from Celebes, from the female sex of which the present species differs in several particulars on the upperside, and conspicuously on the underside, in the presence of the pale blue slightly iridescent spots, these being apparently entirely absent in *P. flavescens*.

This very lovely species is described from an unique example in Dr. Martin's collection taken at Bekantschan, at the foot of the Battak Mountains, in N.-E. Sumatra, in July, 1893. Mr. Hewitson originally obtained it from Sumatra also.

EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1. *Mycalesis (Satoa) maia*, n. sp., ♂, p. 1.
 " 2. " " " ♀, p. 1.
 " 3. *Euthalia (Dophla) eson*, n. sp., ♂, p. 12.
 " 4. *Stichopthalma sparta*, n. sp., ♂, p. 2.
 " 5. *Euthalia (Dophla) eson*, n. sp., ♀, p. 12.
 " 6. *Kerana fulgur*, n. sp., ♀, p. 55.
 " 7. *Erynnis dimila*, Moore, ♂, p. 52.
 J. II. 8

- Fig. 8. *Neptis clinoides*, n. sp., ♂, p. 6.
 " 9. " *nisa*, n. sp., ♂, p. 7.

PLATE II.

- Fig. 1. *Euthalia (Dophla) externa*, n. sp., ♂, p. 13.
 " 2. " " " " ♀, p. 13.
 " 3. " " *curus*, n. sp., ♂, p. 15.
 " 4. " " " " ♀, p. 15.
 " 5. " " *gupta*, de Nicéville, ♀, p. 18.
 " 6. *Lazita laocoon*, n. sp., ♀, p. 20.
 " 7. " *lola*, n. sp., ♀, p. 20.
 " 8. " *lyncestis*, n. sp., ♂, p. 22.
 " 9. " *lola*, n. sp., ♂, p. 20.
 " 10. " *lycene*, n. sp., ♂, p. 21.
 " 11. *Everes moorei*, Leech, ♂, p. 32.
 " 12. *Cyaniris crissa*, n. sp., ♂, p. 31.
 " 13. *Logania luca*, n. sp., ♀, p. 28.

PLATE III.

- Fig. 1. *Argynnis niphæ*, Linnaeus, ♂ and ♀, p. 8.
 " 2. " " " " p. 8.
 " 3. *Euthalia sakii*, n. sp., ♀, p. 9.
 " 4. *Herona pringondani*, Fruhstorfer, ♀, p. 4.
 " 5. " " " " ♂, p. 4.
 " 6. *Euthalia (Dophla) cion*, n. sp., ♀, p. 11.
 " 7. *Herona sumatrana*, Moore, ♀, p. 5.
 " 8. *Euthalia (Dophla) cion*, n. sp., ♂, p. 11.

PLATE IV.

- Fig. 1. *Halpe hieron*, n. sp., ♂, p. 54.
 " 2. *Pithecopa mariæ*, n. sp., ♂, p. 30.
 " 3. *Listeria dudgeonii*, n. sp., ♂, p. 36.
 " 4. *Tajuria blanka*, n. sp., ♀, p. 39.
 " 5. *Papilio (Menamopsis) petra*, n. sp., ♂, p. 47.
 " 6. " (*Pangerana*) *hageni*, Rogenhofer, ♂, p. 45.
 " 7. " (*Menamopsis*) *persee*, n. sp., ♂, p. 46.
 " 8. *Padraona pavor*, n. sp., ♂, p. 53.
 " 9. *Pithecopa mariæ*, n. sp., ♀, p. 30.
 " 10. *Simiskina solyma*, n. sp., ♀, p. 29.
 " 11. *Arhopala constanceæ*, n. sp., ♀, p. 34.

PLATE V.

- Fig. 1. *Gerydus gigantes*, n. sp., ♂, p. 23.
 " 2. *Paragerydus pyzus*, n. sp., ♂, p. 27.
 " 3. *Lampides lucide*, n. sp., ♂, p. 33.
 " 4. *Sepa cronus*, n. sp., ♂, p. 50.
 " 5. *Aphnæus hiendlmayrii*, n. sp., ♀, p. 38.
 " 6. *Sinthusia malika*, Horsfield, ♀, p. 43.
 " 7. *Delias dymas*, n. sp., ♂, p. 44.

- Fig. 8. *Cyrestis theresæ*, n. sp., ♂, p. 18.
 " 9. *Neocheritra namoa*, n. sp., ♂, p. 41.
 " 10. *Charana cepheis*, n. sp., ♂, p. 40.
 " 11. *Gerydus gallus*, n. sp., ♀, p. 25.
 " 12. " *gætulus*, n. sp., ♀, p. 24.
 " 13. " *gigantes*, n. sp., ♀, p. 23.
 " 14. *Paragerydus portunus*, n. sp., ♂, p. 27.
 " 15. *Plastingia vermiculata*, Hewitson, ♂, p. 56.
 " 16. *Camena cremera*, n. sp., ♂, p. 37.
 " 17. *Sinthusia aspra*, Doherty, ♂, p. 44.
 " 18. " *malika*, Horsfield, ♂, p. 43.

On the Chemical Examination of certain Indian Food Stuffs. Part I, Fats and Oils.—By P. C. RAY, D. SC. Communicated by ALEX. PEDLER, F.R.S.

[Read February 7th.]

Of late years a belief has been gaining ground in Calcutta, Bombay and in many other important towns in India, not apparently without reason, that wholesale adulteration is practised in many of the common articles of diet, notably in ghee, butter, milk, mustard oil, &c. The present investigation was undertaken with a view to throw some light on these points, and it embodies the results of work carried on at intervals during the last four years.

PRELIMINARY.

As butter enters largely into the dietary of the people of Europe and America, abundant work has been done by Chemists on its analysis. It is, however, well-known that the composition of milk and of the butter made from it is, within certain limits, dependent on the breed, climate, method of feeding the cows, period of lactation, and so on. The standard for genuine butter as generally accepted in England, especially at Somerset House, cannot therefore be always accepted as a safe guide in this country.

The analysis of the fixed oil of mustard and the various other oils with which it is generally sophisticated also presents considerable difficulties. Not much work has been done in this field. The history of the substances which have been subjected to analysis is seldom given, and the experimental methods are not generally described in sufficient detail to enable the results to be compared. While the information available is meagre on the one hand, the results published from time to time are in themselves in some cases contradictory. It was thus found to be

necessary to work out in the first instance a series of *constants* for such Indian food-stuffs as mustard oil, butter, ghee, &c., which might be of some help in deciding cases of falsification.

Particular care was taken in procuring genuine samples of the substances. The oils were, in many cases, expressed under direct supervision from seeds carefully selected, so that the purity of the products was unquestionable. A sample of pure mustard oil was also obtained through the courtesy of the Superintendent, Alipur Jail, and another of cocoanut oil from the officer in charge of the "Copra" works, Viper Island, Port Blair, with a certificate from him, guaranteeing its purity, and stating it to be a standard sample.

The preliminary examination of the fats and oils is much helped by the determination of certain physical *constants*, *e. g.*, melting point, specific gravity, index of refraction, &c. The work in the present communication is confined solely to the chemical methods. The application of the physical tests, is reserved for a future occasion.

The fats and oils are simply combinations of certain acids, the so-called fatty acids, *e. g.*, butyric, stearic, oleic, palmitic, &c., with glycerin; hence they have been named the *glycerides*. By estimating the amount of both or either of these constituents of fatty substances, valuable information is obtained as to their nature. Now, if a fat be treated with an alkali, the fatty acids contained in it combine with the alkali, resulting in the formation of organic salts, commonly called a *soap*, and the separation of glycerin. It so happens, however, that the molecular weights of some of these fatty acids vary within wide limits. Thus, butyric acid, occurring in butter-fat has a molecular weight equivalent to 88, while erucic acid, a component of mustard oil, has a molecular weight of 338. A molecule of caustic potash weighing 56, will exactly neutralise 88 parts by weight of butyric acid or 338 parts by weight of erucic acid. Hence a given weight of butter-fat will require a far larger proportion of caustic potash to convert it into soap—to *saponify* it, as it is technically called—than the same weight of mustard oil. Koettstorfer has made use of this principle. It has in fact been found by actual experiments that while 100 grammes of butter-fat require very nearly 22 grammes of caustic potash for saponification, the same weight of mustard oil requires only 17 grammes of the alkali. The amount of glycerin in a fat or oil also will vary in a corresponding manner.

Again butyric, caproic and other volatile acids present in cocoa-nut oil, butter-fat, &c., may be easily separated from the non-volatile acids by distillation, and their amount ascertained by their potash neutralising power. Upon this principle is based the well-known Reichert's

test. The amount of iodine absorbed by different fats and oils also lies within wide ranges. The iodine absorption test has been employed with remarkable success by Baron Hübl in deciding cases of adulteration.

The following processes have been made use of:—

1. Direct titration of the fats and oils by alcoholic potash—
Koettstorfer's test.
2. Estimation of the amount of glycerin.
3. Iodine absorption test of Hübl.
4. Estimation of the volatile fatty acids—Reichert's test.

The detailed results obtained by each of these methods as applied in the present inquiry will now be described.

KOETTSTORFER'S METHOD.

Most of the oils, when recently expressed, contain suspended impurities derived from the seeds, &c., in a very fine state of division. These settle down in course of time. The oils thus clarified by subsidence were filtered through bibulous paper to remove any traces of adherent moisture which might be present. The application of even a gentle heat cannot be resorted to for this purpose. Mustard oil, which is classed among the non-drying oils, was found to gain in weight continually when placed inside the chamber of a water-oven and weighed at intervals of 15 to 20 minutes.

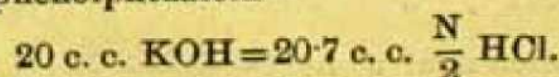
PREPARATION OF ALCOHOLIC POTASH.—The alcoholic solution of potash, approximately of semi-normal strength was prepared by dissolving sticks of potash in pure alcohol. The solution, filtered off the insoluble residue, is generally found to have a reddish-yellow color. It has therefore to be decolorised by shaking with pure animal charcoal.

OIL OF MUSTARD.

Sinapis nigra, *S. alba* (Nat. order—Cruciferae.)

Different samples of mustard seeds were found to yield a fixed oil varying from 32% to 36% of the air-dried seeds.

1. 2.534 gm. oil were weighed into a bottle of about 12 oz. capacity, and 20 c. c. of alcoholic potash solution were added. The mouth of the bottle was closed with an India-rubber cork, fastened by means of wire. The bottle was kept immersed in boiling water for 45 minutes. A blank experiment under exactly similar conditions was made side by side to determine the strength of the potash. The indicator used was phenolphthalein—



4.95 c. c. $\frac{N}{2}$ HCl were required to neutralise the excess of alkali.

(20.7 - 4.95) c. c. or 15.75 c. c. $\frac{N}{2}$ HCl represent the amount of alkali required for the saponification of the oil.

$$1 \text{ c. c. } \frac{N}{2} \text{ HCl} = 0.02805 \text{ gm. KOH}$$

Amount of potash consumed by 1,000 gm. oil (=saponification. equivalent), is therefore equal to $\frac{15.75 \times 0.02805 \times 1000}{2.534} \text{ gm.} = 174.5 \text{ gm.}$

2. 1.713 gm. oil were heated in a flask over a water-bath for ten minutes with 20 c. c. KOH solution, the mouth of the flask being covered by a watch-glass—

$$20 \text{ c. c. KOH} = 20.7 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank experiment)}$$

10.1 c. c. $\frac{N}{2}$ HCl were required by the excess of potash.

$$\text{Saponification equivalent} = \frac{10.6 \times 0.02805 \times 1000}{1.713} = 173.5$$

3. Mustard oil expressed from a different sample of seeds.

3.084 gm. oil were treated with 20 c. c. KOH solution in a bottle, which was immersed in boiling water for about 40 minutes; the mouth of the bottle being closed by an India-rubber cork tied down by means of wire—

$$20 \text{ c. c. KOH} = 20.8 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank titration)}$$

1.5 c. c. $\frac{N}{2}$ HCl were required for the excess of potash.

or 19.3 c. c. $\frac{N}{2}$ HCl represented the amount of alkali used up.

$$\text{Saponification equivalent} = \frac{19.3 \times 0.02805 \times 1000}{3.084} = 175.5$$

4. 2.222 gm. oil were treated with 20 c. c. KOH solution and heated in a flask over a water-bath for 12 minutes; the mouth of the flask being covered with a watch-glass—

Excess of alkali required 7 c. c. $\frac{N}{2}$ HCl

20 c. c. KOH „ 20.8 „ „ (Blank titration).

$$\text{Saponification equivalent} = \frac{13.8 \times 0.02805 \times 100}{2.222} = 174.2$$

5. 1.8012 gm. oil were saponified under the same conditions as described above, with 40 c. c. KOH solution—

$$40 \text{ c. c. KOH} = 32.0 \text{ c. c. } \frac{N}{2} \text{ HCl}$$

$$\text{Excess of alkali} = 21.0 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{0.02805 \times 11 \times 10^8}{1.8012} = 171.3$$

6. Pure mustard oil from Alipur Jail.

3.493 gm. oil were mixed with 20 c. c. potash solution and the mixture kept immersed in boiling water for over half-an-hour. The mouth of the bottle being closed by a cork fastened by a wire—

$$20 \text{ c. c. KOH} = 30.7 \text{ c. c. } \frac{N}{2} \text{ HCl}$$

$$\text{Excess of alkali} = 9.2 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{21.5 \times 0.02805 \times 10^8}{3.493} = 172.7$$

7. Duplicate analysis of the above. 2.195 gm. oil heated to boiling on a water-bath with 20 c. c. KOH solution for 15 minutes, the mouth of the flask being covered with a watch-glass.

$$20 \text{ c. c. KOH} = 30.7 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank experiment)}$$

$$\text{Excess of alkali} = 17.2 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{13.5 \times 0.02805 \times 10^8}{2.195} = 172.5$$

It would thus appear that mustard oil is very easily saponified by alcoholic potash, and that a large excess of the latter is not necessary.

The oil was in some cases found to have a pale yellow color, in others the tint was somewhat deeper. The soap solutions were tinged accordingly. The want of exact uniformity in the tint sometimes interfered with the exact determination of the conclusion of the reaction during the titrations. It may also be stated that the soap solutions were generally diluted with about 25 c. c. of hot water, from which all traces of carbonic acid gas had been driven off by boiling.

In the above experiments it will be seen that the saponification equivalent of the samples of mustard oil has varied between 175.5 and 171.3, the average of the seven determinations being 173.5.

Hence it would be safe probably to adopt the saponification equivalent of mustard oil as lying between 171—175.

SAPONIFICATION EQUIVALENT FOR NIGER-SEED OIL.

Guizotia abyssinica (Nat. ord.—Compositæ).

As this oil is one of the commonest adulterants of mustard oil, a genuine sample of it was procured for experiments.

1. 1.4605 gm. oil were weighed out into a flask, 20 c. c. of alcoholic potash were then added, the mixture covered with a watch-glass and treated to gentle boiling, with occasional agitation for 15 minutes.

$$20 \text{ c. c. KOH} = 15.95 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank experiment)}$$

$$\text{Excess of alkali} = 6.1 \text{ " "}$$

$$\text{Saponification equivalent} = \frac{9.85 \times 0.02805 \times 10^3}{1.4605} = 189.2$$

2. 1.906 gm. oil were saponified as above with 40 c. c. alcoholic potash.

$$40 \text{ c. c. KOH} = 31.9 \text{ c. c. } \frac{N}{2} \text{ HCl}$$

$$\text{Excess of alkali} = 18.8 \text{ " "}$$

$$\text{Saponification equivalent} = \frac{13.1 \times 0.02805 \times 10^3}{1.906} = 192.8$$

3. 2.184 gm. oil were treated as above with 40 c. c. alcoholic potash solution.

$$40 \text{ c. c. KOH} = 31.8 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank experiment)}$$

$$\text{Excess of alkali} = 17.0 \text{ " "}$$

$$\text{Saponification equivalent} = \frac{14.8 \times 0.02805 \times 10^3}{2.184} = 190.0$$

The determinations described above were made in November 1891, when the oil was fresh. It was preserved in a stoppered bottle and a year after (November 1892) the saponification equivalent was found to be 191.6.

The saponification number for niger-seed oil may be taken as 190.

SAPONIFICATION EQUIVALENT FOR COCOANUT OIL.

The sample was obtained from Viper Island, Port Blair, and was guaranteed to be a "standard sample."

1. 1.275 gm. oil were treated with 20 c. c. alcoholic solution and heated to boiling on the water-bath as in the previous cases.

$$20 \text{ c. c. KOH} = 30.45 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank experiment)}$$

$$\text{Excess of alkali} = 18.75 \text{ " "}$$

$$\text{Saponification equivalent} = \frac{11.7 \times 0.02805 \times 10^3}{1.275} = 257.4$$



2. 1.24 gm. oil were treated with 20 c. c. alcoholic potash as above

$$20 \text{ c. c. KOH} = 30.4 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank experiment)}$$

$$\text{Excess of alkali} = 19.0 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{11.4 \times 0.02805 \times 10^3}{1.24} = 257.8$$

3. 1.038 gm. oil with 20 c. c. alcoholic potash solution.

$$20 \text{ c. c. KOH} = 20.4 \text{ c. c. } \frac{N}{2} \text{ HCl}$$

$$\text{Excess of alkali} = 10.8 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{9.6 \times 0.02805 \times 10^3}{1.038} = 259.4$$

The saponification equivalent for cocoanut oil is thus found to lie between 257—260.

SAPONIFICATION EQUIVALENT OF PURE FRESH GHEE (CLARIFIED BUTTER).

1. 13.525 gm. ghee were heated in a water-oven and then kept inside a desiccator for a week. The ghee was then found to weigh 13.5 gm. It would thus appear that ghee is not hygroscopic; nor does it contain any moisture.

1. 1.8196 gm. ghee were treated with 20 c. c. alcoholic potash solution. Details as in the previous cases.

$$20 \text{ c. c. KOH} = 31.0 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank titration)}$$

$$\text{Excess of alkali} = 16.55 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{14.45 \times 0.02805 \times 10^3}{1.8196} = 222.7$$

2. 2.0776 gm. ghee saponified with 20 c. c. alcoholic potash solution.

$$20 \text{ c. c. KOH} = 30.8 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank titration)}$$

$$\text{Excess of alkali} = 14.5 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{16.3 \times 0.02805 \times 10^3}{2.0776} = 220.07$$

3. The same ghee re-melted and filtered. There was no residue on the filter.

1.294 gm. saponified with 20 c. c. alcoholic potash.

$$20 \text{ c. c. KOH} = 30.9 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank titration)}$$

$$\text{Excess of alkali} = 21.45 \text{ ,, ,,}$$

$$\text{Saponification equivalent} = \frac{9.45 \times 0.02805 \times 10^3}{1.204} = 220.1$$

ANOTHER SAMPLE OF GHEE.

1. 1.547 gm. were treated with 20 c. c. alcoholic potash, the mouth of the flask was closed with a cork to which was attached a long glass tube, which acted as a reflex condenser.

$$20 \text{ c. c. KOH} = 16.5 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank tit.)}$$

$$\text{Excess of alkali} = 4.5 \text{ "}$$

$$\text{Saponification equivalent} = \frac{12 \times 0.02805 \times 10^3}{1.547} = 217.6$$

2. 1.1512 gm. ghee treated with 30 c. c. potash.

$$30 \text{ c. c. KOH} = 25 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank tit.)}$$

$$\text{Excess of alkali} = 16.0 \text{ "}$$

$$\text{Saponification equivalent} = \frac{9 \times 0.02805 \times 10^3}{1.1512} = 219.2$$

SAPONIFICATION EQUIVALENT FOR MOWA "BUTTER."

Oil of *Bassia latifolia*—(Nat. order—Sapotaceæ.)

This substance by its physical characters, *e. g.*, color, consistency, melting point, &c., much resembles ghee, and is therefore frequently used for its falsification.

1. 1.396 gm. oil were placed in a stout 12oz. bottle, together with 40 c. c. alcoholic potash solution. The mouth of the bottle was closed with a India-rubber cork, fastened by means of wire. It was then kept immersed in boiling water, with occasional shaking.

40 c. c. alcoholic potash were also heated under exactly the same conditions—

$$40 \text{ c. c. KOH} = 31.6 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank exp.)}$$

$$\text{Excess of alkali} = 21.6 \text{ "}$$

$$\text{Saponification equivalent} = \frac{10 \times 0.02805 \times 10^3}{1.396} = 200.9$$

2. 2.086 gm. oil heated under pressure just as above—

$$20 \text{ c. c. KOH} = 29.3 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank.)}$$

$$\text{Excess of alkali} = 14.6 \text{ "}$$

$$\text{Saponification equivalent} = \frac{14.7 \times 0.02805 \times 10^3}{2.086} = 197.6$$

The soap solutions were perfectly clear and colourless.

To ensure complete saponification it is preferable to treat Mowa oil under pressure as above. If the oil be simply heated on a water-



bath, with a watch-glass at the mouth of the flask, the soap solution is sometimes found to have a turbid appearance, and the Saponification equivalent comes out rather low.

SAPONIFICATION NUMBER FOR MUTTON-FAT.

The fat was melted over a water-bath and filtered to get rid of the shreds of membrane, &c.

1. 1.3906 gm. of fat were treated with 20 c. c. alcoholic potash and heated over a water-bath for 15 minutes.

$$20 \text{ c. c. KOH} = 16.2 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank.)}$$

$$\text{Excess of „} = 6.0 \text{ „ „}$$

$$\text{Saponification equivalent} = \frac{0.02805 \times 10.2 \times 10^3}{1.3906} = 205.7$$

2. 0.9318 gm. of the same sample treated with 20 c. c. alcoholic potash, &c.

$$20 \text{ c. c. KOH} = 16.15 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank.)}$$

$$\text{Excess of „} = 9.3 \text{ „ „}$$

$$\text{Saponification equivalent} = \frac{0.02805 \times 6.85 \times 10^3}{0.9318} = 206.2$$

ANOTHER SAMPLE OF MUTTON-FAT.

0.8354 gm. was treated with 20 c. c. KOH.

$$20 \text{ c. c. KOH} = 16.15 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank.)}$$

$$\text{Excess of „} = 10.2 \text{ „ „}$$

$$\text{Saponification equivalent} = \frac{5.95 \times 0.02805 \times 10^3}{0.8354} = 199.8$$

Duplicate analysis of the same sample gave the number as 199.2.

SAPONIFICATION EQUIVALENT OF OIL OF SESAME.*

Sesamum indicum (Nat. Order : Pedaliaceæ.)

1. 1.6835 gm. oil were heated over a water-bath with 20 c. c. alcoholic potash solution for 15 minutes.

2. 1.3145 gm. oil were heated as above with 30 c. c. alcoholic potash solution.

$$20 \text{ c. c. KOH} = 16.2 \text{ c. c. } \frac{N}{2} \text{ HCl (Blank.)}$$

$$\therefore 30 \text{ c. c. „} = 24.3 \text{ „ „}$$

* The oil was extracted by means of carbon bisulphide.

4.8 c. c. $\frac{N}{2}$ HCl were required by (1) for the excess of alkali.

15.4 " " " " (2) " " "

Saponification equivalent of (1) = $\frac{11.4 \times 0.02805 \times 10^3}{1.6835} = 190.0$

Do. do. (1) = $\frac{8.9 \times 0.02805 \times 10^3}{1.3145} = 189.9$

SAPONIFICATION EQUIVALENT OF LARD.*

1. 1.4245 gm. lard were heated over a water-bath with 20 c. c. alcoholic potash solution.

2. 1.432 gm. lard heated as above with 30 c. c. alcoholic potash solution—

20 c. c. KOH = 15.8 c. c. $\frac{N}{2}$ HCl

∴ 30 " = 23.7 " "

(1) Consumed 5.9 c. c. $\frac{N}{2}$ HCl for the excess of alkali.

(2) " 13.7 " " "

Saponification equivalent for (1) = $\frac{9.9 \times 0.02805 \times 10^3}{1.4245} = 194.9$

" " (2) = $\frac{10 \times 0.02805 \times 10^3}{1.432} = 195.9$

Mean of two = 195.4.

ESTIMATION OF GLYCERIN ACCORDING TO FOX AND WANKLYN'S METHOD, AS IMPROVED BY BENEDIKT AND ZSIGMONDY.

In view of the contradictory statements which have appeared from time to time as regards the applicability of this process, a few preliminary experiments were undertaken with the object of testing its trustworthiness:—

(a) A solution of pure oxalic acid was divided into two equal portions. The oxalic acid was thrown down by means of calcium acetate in presence of acetic acid. The oxalate precipitate was in one case dissolved in hot hydrochloric acid, the solution diluted with water and further acidified with sulphuric acid, warmed to about 60°, and titrated against accurately standardised permanganate solution. In another case the oxalate precipitate was converted by ignition into lime.

* The lard was a standard sample and was not taken off any particular part of the pig's carcass.

(1 c. c. $\frac{N}{10}$ $\text{KMnO}_4 = 0.0028$ gm. CaO). The two results were found to be thoroughly concordant.

(b) Oxidation of glycerin to oxalic acid :—

1. 5.62 gm. of glycerin were weighed into a flask and diluted to 500 c. c. with water. 25 c. c. of the solution were oxidised to oxalic acid.*

25 c. c. sol. = $\frac{5.62}{20}$ gm. glycerin = 0.281 gm. glycerin on the supposition that the sample contained cent. per cent. of glycerin.

The potassium oxalate solution was made up to 500 c. c. of which 100 c. c. gave 0.028 gm. CaO (by ignition)

or 500 c. c. K_2O Sol. = 0.028×5 gm. $\text{CaO} = 0.02 \times 5$ Ca

But 0.002 gm. Ca = 0.0046 gm. glycerin.

$\therefore$ 0.02 gm. Ca = 0.046 gm. glycerin.

or (0.02×5) gm. Ca = 0.046×5 gm. glycerin = 0.23 gm. glycerin.

The Sample thus contained $100 \times \frac{0.23}{0.281}$ or 81.8% of glycerin.

2. 5.895 gm. glycerin (the same sample) were dissolved in water and diluted to 500 c. c., of which 25 c. c. were oxidised to oxalic acid.

25 c. c. sol. = $\frac{5.895}{20}$ gm. = 0.2947 gm. glycerin.

The oxalate solution was made up to 500 c. c., of which 100 c. c. yielded 0.0285 gm. $\text{CaO} = 0.02035$ gm. Ca.

But 1 c. c. $\frac{N}{10}$ $\text{KMnO}_4 = 0.002$ Ca from CaC_2O_4

= 0.0046 gm. glycerin.

$\therefore$ 0.02035 gm. Ca = 0.046805 gm. glyce.

or 500 c. c. oxalate sol. = (0.046805×5) gm. glyce.

$\therefore$ = 0.234 gm. glyce.

The sample thus contained $100 \times \frac{0.234}{0.2947}$ or 79.75% glycerin.

The mean of the above two determinations may be taken as 80% approximately.

SAPONIFICATION OF MUSTARD OIL.

(Estimation of glycerin.)

1. 8.65 gm. oil were saponified according to Allen's method.† The soap solution was treated with dilute sulphuric acid, the beaker in

* An abstract of Benedikt and Zsigmondy's method will be found in *Jour. Soc. Chem. Ind.* IV, 610.

† The use of alcoholic potash is highly objectionable; "pure methyl alcohol" is difficult to procure. "Hence," as Allen remarks, "I have latterly aimed at

which it was contained was immersed in ice-cold water to completely solidify the separated fatty acids. The glycerin solution was then filtered off and made up to 250 c. c. of which 20 c. c. were each time oxidised to oxalic acid. The oxalic acid was thrown down by calcium acetate. The precipitate of CaO was dissolved in HCl , further acidified with H_2SO_4 , and titrated with $\text{N}/10 \text{ KMnO}_4$. The strength of the permanganate solution was ascertained each time by titration against re-crystallised oxalic acid and sometimes against ferrous ammonic sulphate.

7.5 c. c. $\text{N}/10 \text{ KMnO}_4$ were used up by the oxalic acid solution.

1 c. c. $\text{N}/10 \text{ KMnO}_4 = 0.0063 \text{ gm. O} = 0.0046 \text{ gm. glycerin}$; hence amount of glycerin in 20 c. c. sol.

$$= 0.0046 \times 7.5 \text{ gm.}$$

$\therefore$ Total glycerin in 250 c. c.

$$= (0.0046 \times 7.5) \times \frac{250}{20} \text{ gm.}$$

$$= 0.431 \text{ gm.}$$

Per cent. of glycerin in the oil = 4.98.

But the $\text{N}/10 \text{ KMnO}_4 = 0.0061 \text{ gm. O}$ instead of 0.0063 gm. O .

Per cent. of glycerin in the oil = 4.82.

2. 8.48 gm. oil were saponified just as above. The glycerin solution made up to 250 c. c., of which 50 c. c. were oxidised to oxalic acid.

The oxalate solution was divided into two equal portions, one-half (a) (= 25 c. c. glyc. sol.) was acidified with H_2SO_4 , heated to boiling and titrated, the other half (b) was treated with Ca Ac , and the precipitated CaO dissolved in dilute H_2SO_4 and then titrated with $\frac{\text{N}}{10} \text{ KMnO}_4$.

(a) Required 17.0 c. c. $\frac{\text{N}}{10} \text{ KMnO}_4$

(b) „ 15.0 „ „

1 c. c. $\frac{\text{N}}{10} \text{ KMnO}_4 = 0.0046 \text{ gm. glyc.}$

15 c. c. $\frac{\text{N}}{10}$ „ = $0.0046 \times 15 \text{ gm. glyc.} = 0.069 \text{ gm. glyc.}$

$\therefore$ 250 c. c. glyc. solution contains 0.69 gm. glycerin.

Per cent. of glycerin in the oil = 8.14.

Experience has shewn that the oxalate solution if titrated direct, after addition of H_2SO_4 , gives the result too high. Precipitation of the

effecting saponification by aqueous alkali, and thus completely avoiding the source of error in question." *Jour. Soc. Chem. Ind.* V. 70; also Sutton's *Volumetric Analysis*, 6th ed. p. 345.

oxalate as CaO cannot be dispensed with. These experiences are in conformity with those of Allen and Belcher. Two more saponifications carried on as above yielded the percentage of glycerin as 5.3 and 6.0 respectively.

AN IMPROVED METHOD OF SAPONIFICATION.

It is thus evident that the saponification was by no means complete, as the percentage of glycerin ranged between 8.14 and 4.8. Allen's method had thus to be abandoned. It was, in fact, noticed that the oily layer invariably floated over the solution of caustic potash and that shaking simply brought about a momentary incorporation of the oil and alkali. The two layers separated as soon as the bottle was placed in the boiling water. This difficulty was obviated by the introduction into the bottle of asbestos wool, thoroughly ignited previously to get rid of accidental organic impurities. This absorbing medium brought the oil and the alkali into intimate contact with each other and thus complete saponification was ensured. The heating was done just as in the previous cases, *i. e.*, by immersion in boiling water.

1. 1.573 gm. oil were treated as above, the fatty acids liberated by means of dilute H_2SO_4 and filtered off. The mass of asbestos, which had become slimy by the absorption of the fatty acids was then thrown on the filter-paper and repeatedly exhausted with hot water. Scarcely a trace of the fatty acids was found to pass through the filter-paper.* The filtration was carried on with the aid of a Bunsen's pump.

The glycerin solution was made up to 250 c. c., of which 100 c. c. were oxidised to oxalic acid. The latter thrown down as CaO . The CaO dissolved in dilute H_2SO_4 and the solution made up to 250 c. c., of which

$$100 \text{ c. c. reqd. } 4.7 \text{ c. c. } \frac{N}{10} \text{ KMnO}_4$$

$$\text{or } 250 \text{ ,, ,, } 11.75 \text{ ,, ,, } (=100 \text{ c. c. glycerin sol.})$$

$$\therefore 250 \text{ c. c. glycerin solution} = 29.37 \text{ c. c. } \frac{N}{10} \text{ KMnO}_4$$

$$\text{and } 1 \text{ c. c. } \frac{N}{10} \text{ KMnO}_4 = 0.0046 \text{ gm. glyc.}$$

$$\therefore 29.37 \text{ ,, ,, } = 0.135102 \text{ gm. glyc.}$$

$$\text{or } 1.573 \text{ gm. oil yielded } 0.135102 \text{ gm. glyc.}$$

$$\text{whence glycerin } \% = 8.6$$

2. 2.167 gram. oil were saponified as above.

The glycerin solution made up to 250 c. c. of which 100 c. c.

* The filtered solution of glycerin was sometimes perfectly clear, sometimes slightly opalescent.



oxidised to $\bar{O}$, precipitated as $\text{Ca}\bar{O}$, &c., and titrated = $16.0 \text{ c. c. } \frac{N}{10} \text{KMnO}_4$

whence percentage of glycerin = 8.45

3. 1.99 gm. oil saponified as above. Details exactly the same as in the preceding.

250 c. c. glycerin solution = $35 \text{ c. c. } \frac{N}{10} \text{KMnO}_4$

glycerin % = 8.1

4. 1.3165 gm. oil saponified according to the improved method. Details the same as in the previous cases—

250 c. c. glycerin sol. = $25.0 \text{ c. c. } \frac{N}{10} \text{KMnO}_4$

= 0.115 gm. glycerin

glycerin % = 8.7.

The permanganate solution on direct titration against ferrous ammonium sulphate gave

1 c. c. = 5.6 (1 - 0.02) mgs. Fe.

Whence glycerin per cent. (corrected) = $8.7 (1 - 0.02)$
= 8.53

5. 2.0365 gm. oil saponified: details the same—

250 c. c. glyc. sol. = $37.5 \frac{N}{10} \text{KMnO}_4$

Glycerin per cent. = 8.33 (corrected).

6. 1.264 gm. oil saponified as above

250 c. c. glycerin solution = $23.75 \text{ c. c. } \frac{N}{10} \text{KMnO}_4$

Whence glycerin per cent. = 8.64.

It would thus be safe to take the percentage of glycerin in mustard oil as 8.5. The oil used was not in every case identical, but from different samples, in fact, the same as used in the determination of the saponification equivalent.

DETERMINATION OF GLYCERIN IN MUTTON-FAT BY THE ASBESTOS METHOD.

1. 1.0425 gm. fat were saponified under pressure as in the case of mustard oil.

The glycerin solution was made up to 500 c. c. of which 100 c. c. were oxidised to $\bar{O}$. The $\text{Ca}\bar{O}$ was dissolved in dilute H_2SO_4 and made up to

250 c. c.; 50 c. c. of the latter were equivalent to 1 c. c. $\frac{N}{10} \text{KMnO}_4$

or $250 \text{ Ca}\bar{O} \text{ sol.} = 100 \text{ c. c. glyc. sol.} = 5 \text{ c. c. } \frac{N}{10} \text{KMnO}_4$

or 250 c. c. glycerin solution = 25 c. c. $\frac{N}{10}$ KMnO_4

and 1 c. c. $\frac{N}{10}$ KMnO_4 = 0.0046 gm. glycerin

Total amount of glycerin = 0.0046×25 gm. = 0.115 gm.
whence percentage = 11.03.

But, 1 c. c. $\frac{N}{10}$ KMnO_4 when titrated against pure oxalic acid was found to be equal to, 1 c. c. $\frac{N}{10}$ KMnO_4 (1 - 0.02)

$\therefore$ per cent. of glycerin (corrected) = $11.03 (1 - 0.02)$
= 10.81.

2. 1.8877 gm. fat were saponified as above; the heating was continued for 6 days on an average of $3\frac{1}{2}$ hours each day.

The filtrate* (=glycerin solution) was made up to 500 c. c. of which 50 c. c. were oxidised to $\text{K}\bar{\text{O}}$, &c.

The $\text{Ca}\bar{\text{O}}$ sol. was made up to 250 c. c. of which 100 c. c. required

1.7 c. c. $\frac{N}{10}$ KMnO_4

$\therefore$ 250 c. c. $\text{Ca}\bar{\text{O}}$ sol. = $(1.7 \times \frac{5}{2})$ c. c. $\frac{N}{10}$ KMnO_4

or 50 c. c. glyce. sol. = 4.25 c. c. $\frac{N}{10}$ KMnO_4

or 500 „ „ „ = 42.5 „ „ „

whence percentage of glycerin = 10.36

per cent. corrected = $10.36 (1 - 0.02)$ = 10.16

Theoretical percentage of glycerin in mutton-fat, calculated as tri-stearin = 10.33.

DETERMINATION OF GLYCERIN IN NIGER-SEED OIL.

1. 3.165 gm. oil were treated with potash solution and asbestos, &c., as in the case of mustard oil.

The glycerin solution was made up to 250 c. c. of which 50 c. c. were oxidised to $\bar{\text{O}}$, and the $\text{Ca}\bar{\text{O}}$ sol. also made up to 250 c. c.—

50 c. c. $\text{Ca}\bar{\text{O}}$ sol. = 3 c. c. $\frac{N}{10}$ KMnO_4

* The filtrate in the above cases was very faintly milky. It was therefore surrounded by ice-cold water to solidify, if possible, minute traces of fatty acids which might have remained in suspension. The opalescence, however, could not be got rid of. On standing for 3 to 4 days the solution kept in a stoppered flask became clear, but was at the same time the *nidus* of a kind of fungoid growth, resembling flakes of cotton-wool.

$$\therefore 250 \text{ c. c. CaO sol.} = 15 \text{ c. c. } \frac{N}{10} \text{KMnO}_4$$

$$\text{or } 50 \text{ glycerin solution} = 15 \text{ " " "}$$

$$\text{or } 250 \text{ " " "} = 75 \text{ " " "}$$

$$\text{But } 1 \text{ c. c. } \frac{N}{10} \text{KMnO}_4 = 0.0046 \text{ gm. glycerin.}$$

$$\text{Percentage of glycerin} = \frac{75 \times 0.0046 \times 10^2}{3.165} = 10.9.$$

2. 1.704 gm. oil were treated exactly as above, the glycerin solution made up to 500 c. c. of which 100 c. c. were oxidised to oxalic acid. The CaO dissolved in dilute H_2SO_4 was made up to 250 c. c.

$$50 \text{ c. c. CaO sol.} = 1.6 \text{ c. c. } \frac{N}{10} \text{KMnO}_4$$

$$\therefore 250 \text{ c. c. " " "} = 8.0 \text{ " " "}$$

$$\text{or } 100 \text{ c. c. glycerin sol.} = 8.0 \text{ " " "}$$

$$\therefore 500 \text{ " " " " "} = 40.0 \text{ " " "}$$

$$\text{Percentage of glycerin} = \frac{40 \times 0.0046 \times 10^2}{1.704} = 10.8.$$

The percentage of glycerin in niger-seed oil is thus practically the same as in mutton-fat.

ESTIMATION OF GLYCERIN IN BUTTER-FAT.

The oxidation of glycerin by the alkaline permanganate is not applicable in the case of butter-fat, as the soluble fatty acids, *e. g.*, butyric, caproic, &c., it contains yield notable quantities of oxalic acid under the same treatment. The same remarks apply to the case of cocoanut oil (See *Chem. News*, Vol. LXIII, p. 251).

NOTE ON THE FOX AND WANKLYN METHOD OF ESTIMATING GLYCERIN.

This method, although it yields accurate results, can scarcely be made use of by the ordinary commercial analyst on account of its tedious and troublesome nature. Moreover, the manganese precipitate, sometimes bulky, cannot be properly washed without the aid of a Bunsen's filter-pump. The details recorded above will show that each determination of glycerin involves steady work of several hours. If ordinary alcohol be used as a solvent for the fats and oils, saponification is easily effected, but there is considerable risk of the loss of glycerin during the evaporation of alcohol.



ON THE LOSS OF GLYCERIN BY VOLATILISATION.

2.165 gm. glycerin were diluted with water to 250 c. c.; 50 c. c. were each time mixed with 25 c. c. pure alcohol, the latter evaporated off on a water-bath in—

- (1) A platinum basin of 3 in. diameter.
- (2) A porcelain basin of 5 in. diameter.
- (3) Do. do. of about 3 in. diameter.

In (1) and (2) the percentage of glycerin was found to be 74.0; in (3) the percentage was 77.8. The percentage as found before (see p. 69) should have been 80.

It is thus evident that during the evaporation of alcohol considerable quantities of glycerin are carried off.

IODINE ABSORPTION FOR FATS AND OILS.†

COCOANUT OIL.

The sample was the same as used for the determination of the saponification equivalent.

1. 1.3585 gm. oil were digested for 24 hours with 10 c. c. chloroform and 20 c. c. iodine solution. In this as well as in the subsequent analyses a blank experiment was each time made side by side, and under exactly similar conditions, to determine the strength of the iodine solution. The time allowed for digestion was from 18 to 24 hours.

20 c. c. iod. sol. + 10 c. c. CHCl_3 = 35.0 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank exp.)

Excess of iodine = 27.5 " "

Diff. = 7.5 " "

7.5 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ represent the amount of iodine absorbed by the oil.

But 1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ = 0.01265 gm. iodine.

Hence amount of iodine consumed by 100 gm. oil, "iodine degree,"

$$= \frac{0.01265 \times 7.5 \times 100}{1.3585} = 6.99.$$

But the actual strength of the thiosulphate solution, as checked by titration against pure iodine, was found to be equal to 0.01265 (1 - 0.03) gm. per 1 c. c.

Corrected iodine number = 6.99 (1 - 0.03) = 6.78.

2. 1.459 gm. oil were digested as before.

26.5 cc $\text{Na}_2\text{S}_2\text{O}_3$ sol. were taken up by the excess of iodine, and

20 c. c. iod. sol. = 35.0 c. c. $\text{Na}_2\text{S}_2\text{O}_3$.

Iodine degree = $\frac{0.01265 \times 8.5 \times 100}{1.459} = 7.37$

Corrected number = 7.37 (1 - 0.03) = 7.15

† For details of Hübl's method, see *Journ. Soc., Chem. Ind.* iii, 642 also *Allen's Org. Analysis*.

3. 1.016 gm. oil were digested for 24 hours with 20 c. c. I and 10 c. c. CHCl_3

20 c. c. I + 10 c. c. $\text{CHCl}_3 = 16.0$ c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank exp.)

Excess of iodine = 10.4 " "

Dif. = 5.6 " "

Iodine degree = $\frac{0.01265 \times 5.6 \times 100}{1.016} = 6.97$

Corrected number = 6.97 (1 - 0.03) = 6.76.

4. 1.984 gm. oil were digested with 30 c. c. iod. sol. and 10 c. c. CHCl_3 .
Excess of iodine = 13 c. c. $\text{Na}_2\text{S}_2\text{O}_3$.

30 c. c. iod. sol. + 10 c. c. $\text{CHCl}_3 = 24$ c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank exp.)

Iodine degree = $\frac{0.01265 \times 11 \times 100}{1.984} = 7.01$

Corrected number = 7.01 (1 - 0.03) = 6.81.

GHEE (CLARIFIED BUTTER.)

1. 0.955 gm. ghee was digested for 24 hours with 10 c. c. CHCl_3 and 20 c. c. iod. sol.

10 c. c. CHCl_3 + 20 c. c. iod. sol. = 32.8 c. c. $\text{Na}_2\text{S}_2\text{O}_3$

Excess of iodine = 6.3 " "

Dif. = 26.5

Iodine degree = $\frac{0.01265 \times 100 \times 26.5}{0.955} = 35.1$

2. 0.216 gm. ghee was digested as above

27.0 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ was taken up by the excess of iodine.

Iodine degree = $\frac{0.01265 \times 5.8 \times 100}{0.216} = 33.9$

Mean of the two determinations = 34.5

Corrected number = 34.5 (1 - 0.03) = 33.5

The saponification equivalent of this sample of ghee was found to be 221 (See p. 65).

ANOTHER SAMPLE OF GHEE.

1. 0.355 gm. was digested with 20 c. c. iod. sol. and 10 c. c. CHCl_3 . 10.3 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ were required for the excess of iodine.

20 c. c. iod. sol. + 10 c. c. $\text{CHCl}_3 = 22.6$ c. c. $\text{Na}_2\text{S}_2\text{O}_3$

Iodine degree = $\frac{12.3 \times 0.01265 \times 100}{0.355} = 43.8$

2. 0.303 gm. substance was treated with 20 c. c. iod. sol. and 10 c. c. CHCl_3 ; 12.1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ sol. were taken up by the excess of iodine.

Iodine degree = $\frac{10.5 \times 0.01265 \times 100}{0.303} = 43.8$

Mean of the above two determinations = 43.8

But 1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ was equal to (1-0.1) gm. iodine.

Corrected number = 39.4

The saponification equivalent for this sample of ghee was 218 (p. 66).

IODINE DEGREE FOR MUSTARD OIL.

(1) 0.140 gm. oil was digested for about 24 hours with 20 c. c. iod. sol. and 10 c. c. chloroform.

(2) 0.202 gm. oil was digested for the same length of time with 30 c. c. iod. sol. and 10 c. c. CHCl_3 .

20 c. c. iod. sol. + 10 c. c. CHCl_3 = 27.5 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank exp.)

30 " " " = 41.25 c. c. " "

(1) required 16.6 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ for the excess of iodine.

(2) " 25.4 " " " " " "

Amount of iodine consumed by (1) is equivalent to 10.9 c. c. $\text{Na}_2\text{S}_2\text{O}_3$

" " " (2) " " " 15.85 c. c. "

Iodine degree for (1) = $\frac{0.01265 \times 10.9 \times 100}{.14} = 98.5$

" " " (2) = $\frac{0.01265 \times 15.85 \times 100}{0.202} = 98.5$

But 1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ = 1 c. c. I $\times \frac{10}{10.2}$ (as found by actual titration with pure iodine).

Iodine degree (corrected) = 96.9 or 97.0

IODINE DEGREE FOR NIGER-SEED OIL.

(1) 0.137 gm. oil was digested with 30 c. c. iod. sol. and 10 c. c. chloroform.

(2) 0.171 " " " 40 " " " "

(3) 0.098 " " " 30 " " " "

30 c. c. I + 10 c. c. CHCl_3 = 45.2 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank exp.)

Whence also

40 " " " = 60.26 " "

(1) Required 32.0 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ for the excess of iodine.

(2) " 43.4 " " " " "

(3) " 35.6 " " " " "

Iodine degree for (1) = $\frac{0.01265 \times 13.2 \times 100}{0.137} = 121.8$

" " (2) = $\frac{0.01265 \times 16.86 \times 100}{.171} = 124.7$

" " (3) = $\frac{0.01265 \times 9.6 \times 100}{0.098} = 123.9$

The mean of the three numbers is 123.5

$$\text{But } 1 \text{ c. c. Na}_2\text{S}_2\text{O}_3 = 1 \text{ c. c. } \frac{N}{10} \text{I} \times \frac{10}{10.3}$$

Hence the iodine degree (corrected) = 120

IODINE DEGREE FOR EARTH-NUT OIL.*

(1) 0.181 gm. oil was digested with 20 c. c. iod. sol. and 10 c. c. CHCl_3 .

20 c. c. I + 10 c. c. CHCl_3 = 20.8 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank titration)
4.7 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ were required for the excess of iodine.

$$\text{Iodine degree} = \frac{16.1 \times 0.01265 \times 100}{0.181} = 112.5$$

$$\text{But } 1 \text{ c. c. Na}_2\text{S}_2\text{O}_3 = 1 \text{ c. c. } \frac{N}{10} \text{I} \times \frac{10}{11.5}$$

$$\text{Corrected number} = 112.0 \times \frac{10}{11.5} = 97.5$$

(2) 0.1645 gm. oil was treated with 30 c. c. iod. sol. and 10 c. c. chloroform.

(3) 0.1535 " " " 30 " " " "

(2) Required 15.0 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ for the excess of iodine.

(3) " 16.0 " " " " "

The iodine degree for (1) = 103.8

" " " (2) = 103.0

Mean of two determinations = 103.4

$$\text{But } 1 \text{ c. c. Na}_2\text{S}_2\text{O}_3 = 1 \text{ c. c. } \frac{N}{10} \text{I} \times \frac{10}{10.5}$$

$$\text{Hence corrected number} = 103.4 \times \frac{10}{10.5} = 98.5$$

MOWA FAT.

(1) 0.1815 gm. oil was treated with 10 c. c. CHCl_3 and 20 c. c. iod. sol.

(2) 0.186 " " " and 30 c. c. " "

11.5 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ were reqd. for the excess of iod. by (1)

21.5 " " " " " (2)

20.0 c. c. iod. sol. + 10 c. c. CHCl_3 = 20.6 c. c. $\text{Na}_2\text{S}_2\text{O}_3$

30.0 " " " " = 30.9 " "

From which we get the iodine degree for

(1) as 63.42, and that for (2) as 63.88

Mean of two = 63.7

$$\text{But } 1 \text{ c. c. Na}_2\text{S}_2\text{O}_3 = 1 \text{ c. c. } \frac{N}{10} \text{I} \times \frac{10}{10.3}$$

$$\text{Corrected number} = 63.7 \times \frac{10}{10.3} = 61.8$$

* The saponification equivalent of this sample was found to be 195.0.



IODINE DEGREE FOR SESAME' OIL.*

(November 29, 1893.)

(1) 0.2806 gm. oil was digested with 20 c. c. iod. sol. and 10 c. c. CHCl_3 .

5.9 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ were required for the excess of iodine.

20 c. c. I = 29.8 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank exp.)

$$\text{Iodine degree} = \frac{23.9 \times 0.01265 \times 100}{0.2806} = 107.7$$

But 1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ had the actual strength 1 c. c. $\times (1 - 0.02) \frac{N}{10}$ I

$$\text{Corrected number} = 107.7 (1 - 0.02) = 105.5$$

(December 5, 1893.)

(2) 0.1721 gm. oil was digested with 20 c. c. I sol. and 10 c. c. CHCl_3

(3) 0.2065 " " " " " "

(4) 0.227 " " " " " "

20 c. c. I sol. + 10 c. c. CHCl_3 = 25.5 c. c. $\frac{N}{10}$ $\text{Na}_2\text{S}_2\text{O}_3$ (Blank titration)

No. (2) required 10.9 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ for the excess of iodine.

No. (3) " 8.2 " " " " "

No. (4) " 6.4 " " " " "

From which we get the iodine degree for

$$\left. \begin{array}{l} (2) = 107.3 \\ (3) = 106.0 \\ (4) = 106.4 \end{array} \right\} \text{mean} = 106.6$$

But 1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ = 1 c. c. I (1 - 0.02)

$$\text{Corrected number} = 106.6 (1 - 0.02) = 104.5.$$

IODINE DEGREE FOR LARD.

(1) 0.2215 gm. lard was digested with 20 c. c. I and 10 c. c. CHCl_3

(2) 0.1995 " " " " " "

15.1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ were required by (1) for the excess of iodine

16.1 " " " " (2) " " "

20 c. c. I + 10 c. c. CHCl_3 = 24.1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ (Blank exp.)

$$\text{Iodine degree for (1)} = \frac{9 \times 0.01265 \times 10^3}{0.2215} = 51.4$$

$$\text{" " (2)} = \frac{8 \times 0.01265 \times 10^3}{0.1995} = 50.7$$

Mean of the two determinations = 51.0

But 1 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ = 1 c. c. $\frac{N}{10}$ I $\times (1 - 0.02)$

Whence corrected number = 50.0

* The oil was extracted from the seeds by means of carbon bisulphide, and it was the same as used for determining the saponification equivalent.

NOTE ON HÜBL'S IODINE ABSORPTION METHOD.

There is some difference of opinion as regards the excess of iodine which should be present after its absorption. Thompson and Ballantyne, who have carefully revised the constants required in the analysis of some fats and oils, are of opinion that "at least double the amount of iodine absorbed should be present." Care was taken to fulfil this condition in most of the analyses as recorded above. On reference to sesamé and earth-nut oils, it would appear, however, that it is not always necessary that the iodine should be in large excess. Thus in one case the excess of iodine corresponds to only 5.9 c. c. N/10 $\text{Na}_2\text{S}_2\text{O}_3$ solution, and in another to only 4.7 c. c. $\text{Na}_2\text{S}_2\text{O}_3$ solution without the results being discordant.

For convenience of reference the results obtained above are presented below in a tabulated form:—

Table of constants in the analysis of fats and oils.

NATURE OF FAT OR OIL.			Saponification equivalent.	Glycerin per cent.	Iodine absorption.
Mustard oil	...	...	172-176	8.5	97.0
Niger-seed oil	...	...	190.0	10.8	120
Cocoanut oil	...	...	258.0	...	6.9
Ghee ...	...	...	218-222	...	33.5-39.4
Mowa fat	...	...	199.3	...	61.8
Mutton tallow	...	...	199.5-206	10.5	
Sesamé	...	...	189.9	...	104.5
Lard ...	...	...	195.4	...	50.0
Earth-nut oil	...	...	196.0	...	98.0

SUMMARY AND CONCLUSION.

It would thus appear that as the saponification equivalents of niger-seed oil, mowa fat, mutton tallow, sesamé oil, lard and earth-nut oil are very close to one another, their admixtures in considerable proportions cannot be detected by Koettstorfer's test. Even the saponification equivalent of ghee is not far removed from that of lard or tallow. The saponification equivalents of mustard oil and cocoanut oil are, however, highly characteristic. The iodine degrees, on the other hand, afford us valuable hints as to the nature of adulteration, the most remarkable feature being the exceedingly low numbers for cocoanut oil and ghee. The results of the application of Reichert's test will be communicated later on.